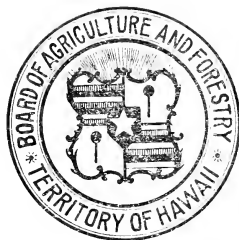


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TERRITORY OF HAWAII
BOARD OF AGRICULTURE AND FORESTRY

REPORT
OF THE
DIVISION OF ENTOMOLOGY
FOR THE YEAR ENDING
DECEMBER 31, 1905.

REPRINT FROM THE SECOND REPORT OF THE BOARD OF COM-
MISSIONERS OF AGRICULTURE AND FORESTRY.



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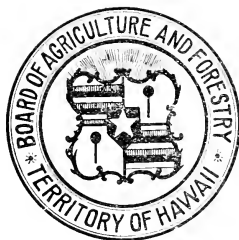
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REPORT

DIVISION OF ENTOMOLOGY

REPRINT FROM THE SECOND ANNUAL REPORT OF THE BOARD
OF COMMISSIONERS OF AGRICULTURE AND FORESTRY



HONOLULU :

HAWAIIAN GAZETTE Co., LTD.

1906

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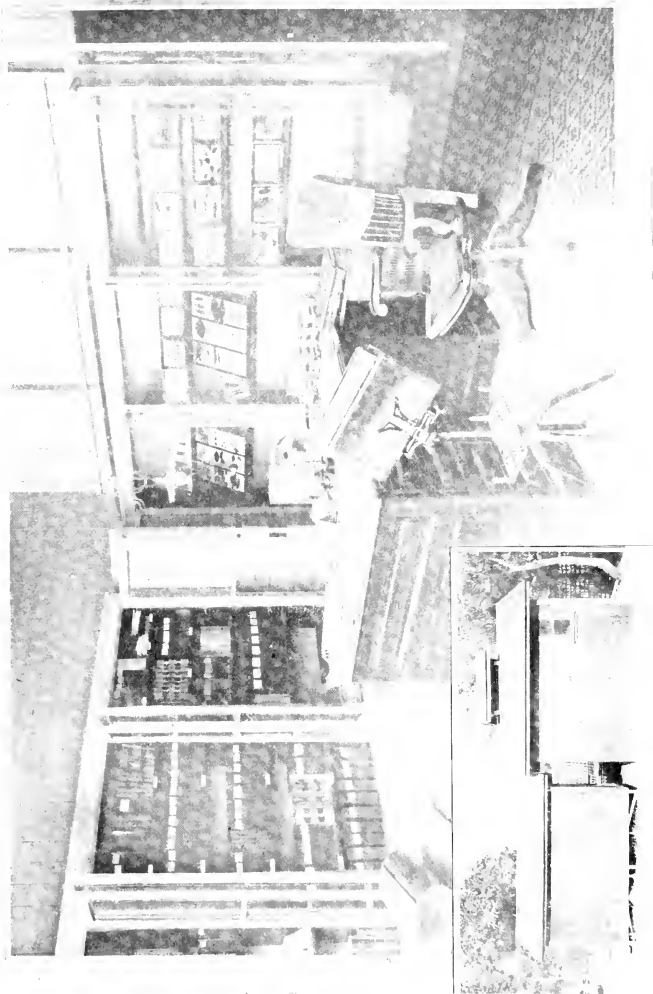


FIG. 1. OFFICE OF ENTOMOLOGIST. FIG. 2.—INSECTARY AND FUMIGATING HOUSE.

DIVISION OF ENTOMOLOGY.

Report of Superintendent of Entomology and Inspector.

Honolulu, T. H. Dec. 31, 1905.

To the

Honorable Board of Commissioners of
Agriculture and Forestry,
Honolulu, T. H.

Gentlemen:—I herewith present a synopsis of the agricultural-horticultural quarantine work performed by your officials for the calendar year 1905. The value and importance of the above work can only be judged from the experience of the Islands in the past, as it is a well known and conceded fact that all the injurious insects and diseases of plants and trees are introduced species that have entered upon plants from other countries. It would be utterly impossible for such pests to enter this Territory by natural distribution of their own migration. From the isolated position we are in, if the quarantine had been instituted earlier in the history of the country, it would have remained a paradise free from such pests, for with inspection, disinfection, or fumigation, it would have been practically impossible for the vast hordes of devastating insects and diseases to have secured lodgement here.

When we take into consideration that our loss from insects alone in the United States amounts to four hundred millions of dollars annually, principally from imported insects, we feel that the above is an under estimate, when we consider that our own "Hawaii nei" lost in one crop (sugar) two years ago over three millions of dollars by the depredations of an imported pest. This was a serious loss for one year from such a small insect as the "cane leaf-hopper" (*Perkinsiella saccharicida*, Kirkaldy). Your Board, with the co-operation of the Ha-

waian Sugar Planters' Association, took up the matter in the only logical way of combating pests and despatched two experts to the home of the hopper where they studied up the natural enemies of the pest and succeeded in introducing a few living specimens that were carefully bred and liberated under proper environments where they rapidly increased and spread until now they are destroying over fifty per cent of the hopper eggs. At this rate of check to them in a period of one year it is natural to surmise that this pest has reached the limit of its destructiveness, and the loss from that source will hereafter be diminished to a normal condition.

However, it is best to prevent the introduction of all vegetable eating insects, for it requires time to determine how serious they may become without their natural check, and in that time it is generally too late to try and exterminate them by artificial methods.

AGRICULTURAL-HORTICULTURAL QUARANTINE WORK.

SUGAR CANE PESTS.

In January a box of sugar cane arrived from Australia; upon inspection the cane was found to be infested with boring lepidopterous larvae measuring from $1/16$ to $3/4$ of an inch. Those worms burrow into and under the buds, destroying them for cuttings, and injuring the vitality of the cane. A number of "mealy bugs" (*Pseudococcus*) was also found under the leaves, as it was a new variety of cane, and being desirous of thoroughly disinfecting it from "bud worms," we used a strong charge of carbon-bisulphide. Evidently, however, sugar cane will not stand as strong a charge of that vapor as grape vines, or other plants or seeds requiring treatment by that method, for most of the cane was killed as well as the bud worms and "mealy bugs."

Another importation of sugar cane received from Fiji was treated with hydrocyanic acid gas before unpacking in order to destroy any insects that might have developed in coming through the tropics and liable to escape when the case was un-

packed. Each piece was inspected with the following result: One cane borer beetle and two larvae of the same; one larva of a small *Buprestid* beetle cutting a transverse tunnel slightly under the surface, also a few adults and larvae of "mealy bugs" (*Dactylopius calceolariae*).

Two packages of sugar cane cuttings came in by mail from Queensland; upon inspection the cane was found to be seriously attacked by a skin fungus, first appearing on the cane in small pustul-like protuberances, afterwards rupturing the skin from which issue the black fungus threads; besides the above fungus, strong colonies of "mealy bugs" were hidden at the base of the leaves that were in a healthy condition and breeding as if they were in a cane field. The cane and packing was burned, saving samples of each pest in glass jars containing formalin.

Another importation of sugar cane, this time from the Philippine Islands, consisted of two packages done up in bamboo. The sugar cane contained evidence of what appeared to be a *Lepidopterous* cane borer and numerous punctures made by "leaf-hoppers." We consigned cane and packages to the fire.

COCOANUT PESTS.

In January a local schooner brought a cargo of cocoanuts, including fourteen hundred and fifteen young trees for sale, from the Island of Palmyra; upon inspection we found the trees infested with small worms destroying the leaves and differing from the cocoanut palm worm (*Omiodes blackburni*). The leaves were also infested with microscopic, light colored mites that were feeding upon the chlorophyll, giving the leaves a blotched appearance. All the trees were destroyed by fire and we sealed down all hatches and closed up all ports, doors, etc., with paper pasted over to prevent the escape of the gas; we fumigated the entire vessel with quadruple strength of hydrocyanic acid gas.

COCOANUT CRAB.

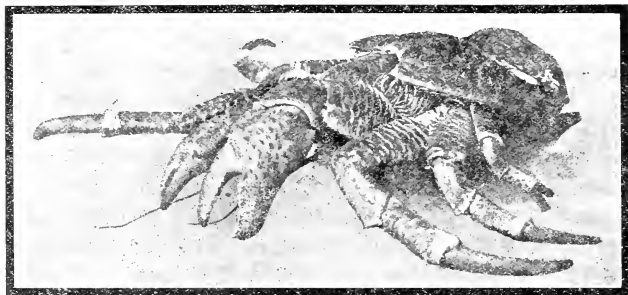
(Birgus latro)

FIG. 1.—Coconut Crab (*Birgus latro*), about 1-5 natural size (original).

On the same schooner was also imported a monster Coconut Crab. This is a very destructive crustacean and coming under Rule II of your regulations prohibiting its landing, we killed it by fumigation and a photograph is herewith given; it had two powerful jaws, one of which it used to crush and open cocoanuts upon which it lived. It had a spread of eighteen inches and beautifully colored, blue predominating.

ARRIVAL OF SUGAR SHIPS IN BALLAST.

Several vessels of the sugar fleet have come in with ballast. Upon inspection and before permission was granted to discharge we were assured by the Captain of each vessel that their ballast was obtained from Telegraph Hill, San Francisco; it consisted of broken rock and some sandy soil. During the discharging of the ballast it was occasionally examined without finding anything detrimental to agriculture. The material was used to fill in along the water front.

PESTS FROM FLORIDA.

Through orders from the Department of Agriculture, Washington, D. C., five packages of Mango grafts were received by a

resident of the Islands from Florida, having the following insect pests that upon a microscopic examination showed them to be still alive.

Crysomphalus dictyospermi in various stages of development, a fringed scale (*Asterolecanium*, sp.), also the "greedy scale," (*Aspidiotus rapax*) and a bark fungus. The owner's attention was called to the condition of the grafts and he offered no objection to their destruction by fire.

INFESTED FLORIDA ORANGE TREES.

Twelve budded orange trees covered with "chaff scale" (*Parlatoria pergandei*), also a liberal supply of *Lepidosaphes beckii* came by mail and were burned.

DANGER FROM FLORIDA ORANGE TREES.

Citrus trees from Florida or Louisiana are liable to bring with them the destructive "white fly" (*Aleyrodes citri*) that has proved such a loss to those States. This insect is closely related to scale insects, but differs, as the females, as well as the males, are winged and each has two pairs, so can spread of their own volition; on this account they are more difficult to control either with sprays or fumigation, so I would advise that no citrus trees be purchased from either State.

Two packages of semi-tropical plants by mail from Florida contained a *Pulvinaria* and *Lecanium*, which we fumigated much to the indignation of the owner, as he said that he had a letter from the nurseryman informing him that the plants were absolutely free from insect pests.

OFFICIAL CARELESSNESS.

Five large wardian cases of plants arrived in August from the Department of Agriculture, Washington, D. C., accompanied by certificates that the plants were free from insect pests and a letter to one of the owners, expressed the hope that the quarantine inspectors at Honolulu would make no

trouble for him. Naturally the owner considered that such a certificate would act as a "carte blanche" for his plants and they would require no further inspection. As this Territory is most interested in the condition of such imported stock we prefer to make our own examination and in this case we found the following injurious living insect pests. One owner was present during the inspection and personally saw that the following insects were alive:

Coccus longulus in various stages.

Saissetia oleae containing eggs.

Pulvinaria camelicola.

Lepidosaphes beekii.

Chrysomphalus ficus in various stages.

Aspidiotus, sp.

The first two named were sufficiently numerous so that no experienced inspector should have overlooked them. The entire shipment was fumigated with hydrocyanic acid gas and has been twice subsequently inspected without finding any living insects.

The sending out of such infested plants I consider nothing less than criminal, and the enormous loss sustained by the people of the country by imported insect pests should be sufficient cause for the Department of Agriculture at Washington, to have all plants entering the United States to be rigidly inspected and fumigated before propagating and distributing them broadcast over the country.

The Pacific States, I believe, are the only ones that have horticultural quarantine laws against imports, but the Federal Government should certainly see that all plants imported by its officials are freed from pests and disease.

A DANGEROUS SHIPMENT.

Upon the arrival of the S. S. "Manchuria" from Japan, we found two boxes on the bridge containing trees; one of the

boxes was fitted up with fine brass wire-cloth ventilators through which I observed great numbers of the destructive "Gipsy moth" (*Porthetria dispar*) caterpillars. This box was not provided with a lock, so I had the door fastened with large screw nails to prevent the over inquisitiveness of any one that felt disposed to open it and thus release this terrible scourge in our midst. The other box contained growing trees from which to cut food for the caterpillars should they require it. Those trees were also seriously infested with a species of "Saw-fly" larvae that were rapidly defoliating the trees. I purchased eighteen yards of mosquito bar, with which we wrapped the trees and crate to prevent the escape of any insects that might have developed on the voyage. The Gipsy moth was unfortunately introduced into Massachusetts about thirty years ago and in recent years has cost over a million dollars annually in a vain attempt to stamp it out, but with all that outlay they have not even been able to check its spread.

AUTHORITIES AWAKENING.

It is pleasing to note that at last the Massachusetts authorities are awakening to the fact that it is useless to attempt the extermination of that pest by artificial methods and have at last made an effort to introduce its natural enemies. This I learned by a letter from Prof. S. I. Kuwana, that he had forwarded the "Gipsy moth" caterpillars with parasites from Japan at the request of U. S. Consul Griscom.

MANILA HEMP PLANTS.

Musa textilis.

A shipment of twenty Manila "hemp banana" plants and five rubber trees came from the Department of Agriculture, Washington, D. C., and were in good condition and free from pest or disease.

ANOTHER DANGEROUS INTRODUCTION.

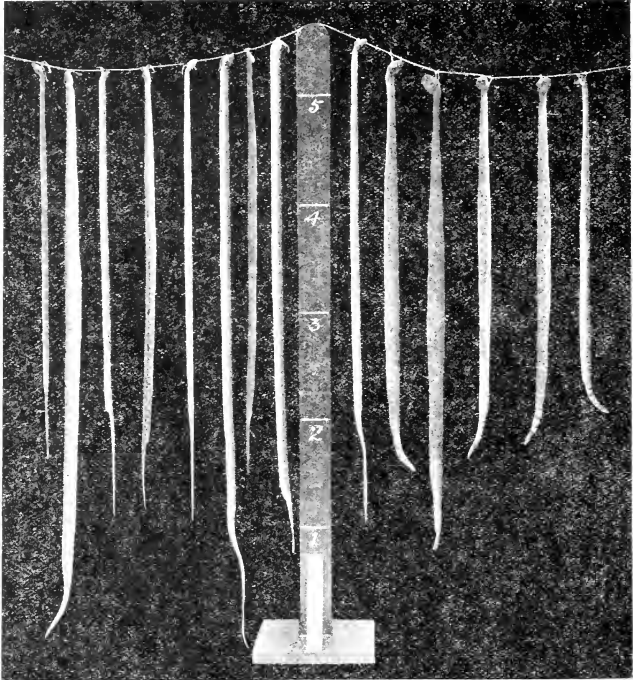


FIG. 2.—Diamond-back rattlers and other snakes (original).

Poisonous and Other Reptiles.

The Hawaiian Islands have always been famed for their freedom from snakes and our people and animals could wander with impunity through our valleys and over the hills and mountains. An importation arrived on the 2nd of June ex S. S. "Alameda" from California, that might have put an end to such delightful serenity. This was the arrival of three

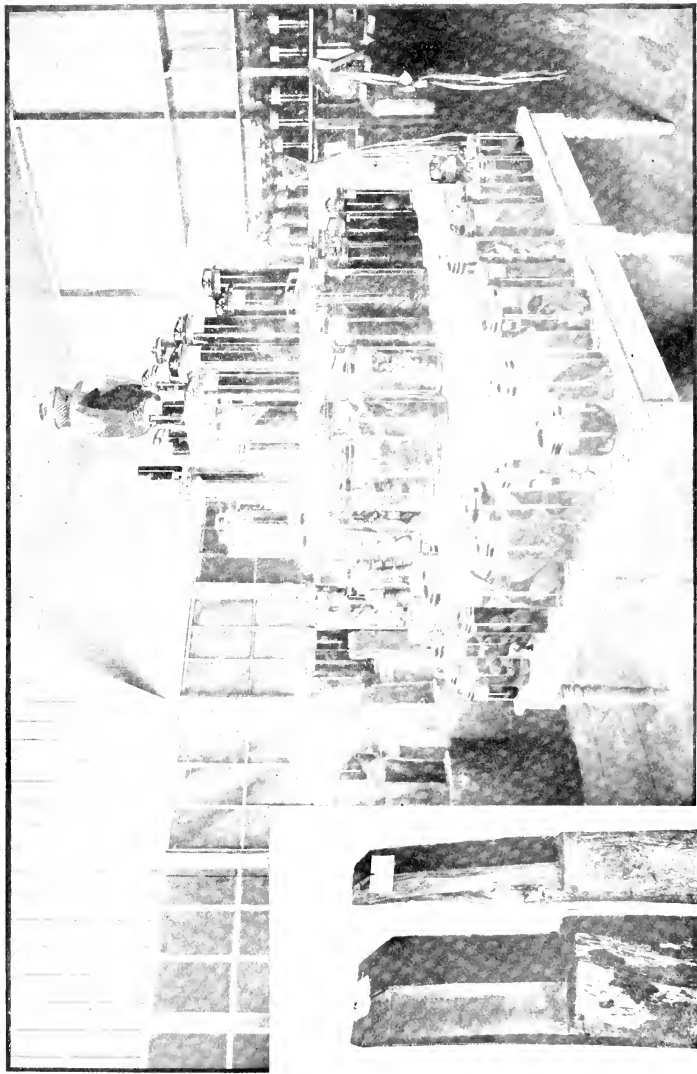


EXHIBIT ROOM, BOARD OF AGRICULTURE AND FORESTRY. COLLECTIONS OF NATIVE AND ISLAND-GROWN WOODS AND FRUITS.

flimsy boxes, containing fourteen large, living snakes, five of them the deadly Rattler. Under Rule II, as published in your *General Circular No. 2*, "such animals arriving in the Territory of Hawaii are ordered to be immediately destroyed or deported." In order that there should be no hitch in the proceedings, I took the precaution and telephoned to Mr. W. A. Bryan, who is Federal Inspector of wild animals. He came to the dock and after discussing the matter with Collector of Customs E. R. Stackable and Territorial Commissioners of Agriculture and Forestry, L. A. Thurston and Alfred W. Carter, he informed us that he would refuse to issue a permit to land the snakes. The reptiles were intended for exhibition and in order that there should be no question about the proceedings, the three above named gentlemen made a proposition to the importer to pay him the purchase cost of the snakes and then they would take possession of them. This was a generous act on their part in order to keep the Islands free from such a curse, but they should not have been put to that expense by the blunder of another person that should have been and was, undoubtedly, aware of the Federal and Territorial laws relating to the introduction of animals. In the destruction of the snakes we had a surprising experience. I placed the boxes of snakes in one of our fumigating chambers and applied a charge of double density of hydrocyanic acid gas and the snakes were still alive at the end of fifteen minutes, whereas, if they had been warm blooded animals they would have succumbed in a less number of seconds. They were again shut up and a quadruple charge of that deadly gas was administered and at the end of one hour and a half the fumigator was opened and several of the snakes still showed signs of life. We then immersed them in 95% of alcohol and that soon put an end to their venomous existence. A fitting death, as the same liquid—in a modified form—is considered an antidote to their deadly bite.

I wrote to the Hon. James Wilson, United States Secretary of Agriculture, Washington, D. C., giving him a full account

of the recent attempted introduction of snakes into Hawaii and the disposition of them. Other organized bodies in Honolulu also addressed Mr. Wilson upon the same subject and he issued a *Biological Survey Circular* (No. 48), the purpose of which reads as follows:

“In accordance with the authority thus conferred, and for the purpose of preventing the introduction of snakes into the Territory of Hawaii, the order issued under date of May 22, 1902 (*Circular No. 36, Biological Survey*), is hereby amended so that on and after August 1, 1905, and until further notice, no permits shall be issued for the entry of snakes, of any kind, at any port of the Hawaiian Islands.

“Shipments of snakes presented for entry will be immediately destroyed or returned to the port from which exported at the expense of the owner or agent.”

This is another proof of Secretary Wilson's desire to assist us in preventing the introduction into Hawaii of undesirable pests (see pages 141-142 of your report for 1904).

MAIL IMPORTS.

Further proof of the advisability for the inspection of even such small plants as can be sent by mail has been forcibly brought to our attention the past year, and through the kindness of Postmaster Joseph G. Pratt of Honolulu, your request for permission to inspect all packages of plants and seeds entering this Territory by mail has been favorably considered by the Postmaster General, and we have frequently intercepted the introduction of pestiferous insects and diseases as recorded in our reports to your Honorable Board, of current work, which reports are on file in this office.

Besides those already referred to in this synopsis, the following may have special interest and refresh your memory.

In December, among other packages of agricultural matter, was one containing “chives” from Philadelphia, that we found infested with larvae and pupae of the “onion fly” (*Phorbia ceparum*). This pest is a very difficult one to combat,

as like the "melon maggot," it is practically out of the reach of the usual treatment for insect pests. I called the attention of Postmaster Pratt to the condition of the contents of the packages and he immediately notified the owner by telephone, who offered no objections to our condemning the package. As we were desirous of securing perfect specimens of the "onion fly" for our cabinet collection, I turned it over to Mr. Kotinsky, who bred out the perfect insect in a glass jar in our insect-proof breeding room.

Another package by mail contained thirty-two living pupae of *Platysamia cecropia* and *P. cynthia*. I called upon the owner of the package and he wrote out a request to Mr. Pratt to turn the package over to me, which he did and they were placed where no damage to the interest of this Territory would accrue from their importation. The former is one of the largest moths, the larvae average six inches in length and are very general feeders.

DESTRUCTION OF INFESTED CITRUS FRUITS.

During November and December various consignments of citrus fruits arrived from Japan and China, aggregating 2950 cases, that were seriously infested with injurious insects and diseases, a full detailed record of which was presented your Honorable Board at the time. The fruit and cases were all destroyed by burning. We were threatened and served with papers for law suits for damages by the importers, but under the advice of Attorney General E. C. Peters, we carried out your regulation and the laws of the Territory of Hawaii, thus preventing the further introduction of more pests and blights. The importers were granted the privilege of exporting the fruit, but as the great distance would hardly warrant this expense, it was not done. In the case of condemned fruits from the mainland this is frequently done, although we sometimes have to resort to destruction of fruits and produce from there also. One hundred and fifty orange trees infested with leaf-miners from Japan were burned, also numbers of other trees

and plants from the mainland and other parts that were infested with destructive pests or diseases.

IMPORTATIONS.

During the year 1905 there were examined two hundred and ninety-three vessels, on which we found 104,829 packages of fruits, vegetables, plants, etc., as freight, and during the same time we had two hundred and forty-nine packages by mail, of which we have given you detailed reports. This work has been performed by my assistant, Mr. C. J. Austin, and myself; also the fumigation with hydrocyanic acid gas and carbon-bisulphide fumes, as necessary.

As mentioned in my detailed report to you we have been called upon at various times, personally and by letters, for information in relation to the depredations of insects attacking other than strictly agricultural products. However, as they directly affected Hawaii's interests we gladly gave the necessary advice and assistance.

RECOMMENDATIONS.

INTRODUCTION OF BENEFICIAL INSECTS.

Through the efforts of your Honorable Board several species of internal parasites and predaceous insects for the suppression of our destructive species have been introduced, and from examination we feel hopeful that they will come up to our expectations. As Mr. Kotinsky has referred to this work in detail, it will not be necessary to take this matter up further than to suggest that you bring this important work before the attention of our Territorial Legislators, urging them to make a liberal appropriation at their next session, so as to enable you to further continue the search for such friendly assistants to our agriculturists. There is positively no danger from the intelligent introduction of such insects that prey upon injurious species, for their stomachs will no more digest vegetable matter than that of a lion's or tiger's will. Such insects, when

once introduced, are constantly working without pay in the interests of our farmers, planters, and in fact, all lovers and cultivators of trees and plants, not even exacting a portion of our crops as their part. What all this means can be gleaned from the introductory remarks or statement in this report of the enormous loss by the depredations of insect pests. It is the introduced injurious species that prove to be such formidable ones, as they are usually brought into new countries without their more highly bred, natural checks, which can generally fly away during the time occupied in the transportation of the plants. This way of fighting our insect enemies is not any longer an experimental one, but has saved millions of dollars of property, besides retaining the value of adjoining property already improved or unimproved. Not only is our farming population increased but our merchants, tradesmen and bankers, also feel the effects of the improved agricultural conditions,—so all our people are benefited by the expenditure of money in this work.

We have in Prof. Albert Koebele one of the best and most competent and successful collectors of beneficial insects in the world, so that any money appropriated for such work will be expended in the best manner, in the interest of these Islands, as his past work has fully demonstrated. As a business proposition I feel confident that our legislators will not hesitate in furnishing you with ample funds to carry out this work so successfully started.

INTER-ISLAND INSPECTION.

Besides the foregoing suggestions, I would strongly urge your Honorable Board to bring before the Legislature the great necessity of their making provision for the payment of two additional inspectors, one to look after vessels entering the port of Hilo and the other at Kahului. As the amount of imports entering either place will not be sufficient to call for the entire time of such inspectors they can be paid for the actual time employed in such work. Your past efforts in guarding

those ports through the kindness and co-operation of the Hon. E. R. Stackable, Collector of Customs at Honolulu, allowing his deputies to act as Honorary Entomological Inspectors at the various sub-ports may have appeared as a wise economical measure. I, however, question the soundness of that system. It is possible, probably, to find one gentleman in one hundred that is a first class man and officer for Mr. Stackable, who is also by training, or by nature, a practical inspector of plants or vegetable products, and while the gentlemen that have acted for the past two years, as a side issue to their own duties cannot be even accused of having allowed any pests to have passed them. It is, however, a well known fact that certain insects that are at present causing considerable alarm among agriculturists on other than Oahu are to be found on several of our sister Islands, and in order to prevent the spread or interchange of such pests to every county of the Territory of Hawaii, I strongly urge the appointment by your Honorable Board of one or more extra officers to look after all inter-island steamers or transportation companies and give careful scrutiny of all agricultural or horticultural products. This can be done without any serious delay to any business and certainly the objects to be derived from such work will justify any expenditures you may make a thousand fold.

Respectfully submitted,

ALEXANDER CRAW,
Superintendent of Entomology and Inspector.

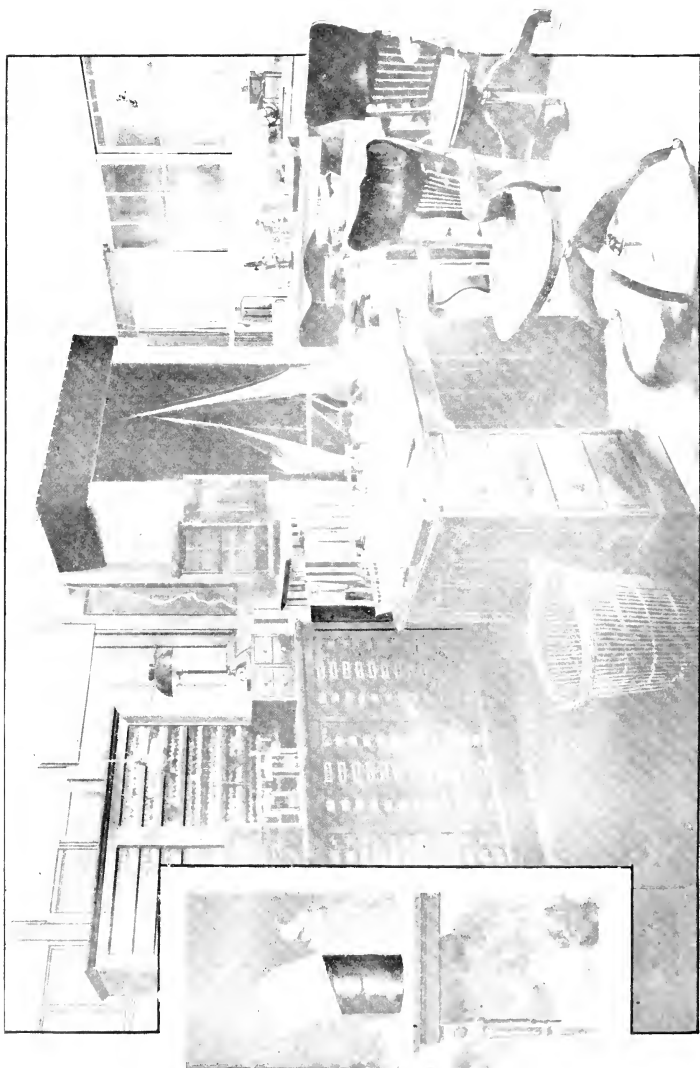


FIG. 1.—LABORATORY, DIVISION OF ENTOMOLOGY. FIG. 2. METHOD OF BREEDING PARASITES.

Report of the Assistant Entomologist.

By JACOB KOTINSKY.

Honolulu, T. H., December 31, 1905.

Mr. Alexander Craw,

Superintendent of Entomology and Inspector,
Honolulu, Hawaii.

Dear Sir:—During the year just past my attention was principally occupied with breeding and distribution of beneficial insects; breeding and study of injurious insects and their enemies; identification of insects brought or sent to the office; classification and arrangement of collections; selection and purchase of books and supplies; the usual routine of correspondence attendant upon the above, and attention to visitors. Two circulars were written and published during the year, and, beginning with September, a popular monthly contribution on timely entomological topics was made to the *For-ester*. Two inter-island trips were made during the year and many official visits paid in and about Honolulu and other portions of Oahu.

I. BREEDING BENEFICIAL INSECTS.

At the beginning of the present year Messrs. Koebele and Perkins were still in Australia, and before returning in April Mr. Koebele spent some time in Fiji. From these countries he continued sending beneficial insects which were cared for in this office.

VERANIA SP.

This species of ladybird was collected in Condong, New South Wales, where it was found to be a powerful aphid enemy. A number were brought by Mr. Perkins when he came on the "Miowera," January 13, 1905. Only two specimens survived the voyage and these succumbed without issue.

DUNG BEETLES.

Out of three hundred of these collected in Mittagong, New South Wales, a little over one hundred reached us alive on February 7, 1905. That very day they were released upon a cattle ranch near Honolulu. Most of these beetles were what are known as "tumble bugs," because of their habit of rolling dung into spherical pellets and carrying them down into a previously made burrow in the ground. It was hoped that if they increased in sufficient numbers they would disintegrate cattle droppings before the hornfly has had opportunity to develop in them.

Another consignment of these insects reached us on February 28, 1905, but most of these were dead and the few survivors died soon afterwards.

PARASITES OF DUNG FLIES (*Diptera*).

A large number of dung larvae and pupae was collected by Mr. Koebele in Condong, near Sydney, and reached us in good condition on February 28, 1905. A large number of parasites subsequently issued from these and two strong colonies were located on ranches on Oahu. On two occasions these were visited later, but no evidence was found to indicate that either the parasite or the dung beetle were established.

ASIATIC LADYBIRD (*Chilocorus similis*, Rossi).*

Dr. Nicholas Russel of Olaa, Hawaii, has long been one of the most intelligent and valued correspondents of the Board's Entomological Division. Recently he went to Japan. At the request of Mr. Craw, who supplied him with letters of introduction to entomologists in Japan, he undertook to introduce into the Territory what beneficial insects he may come across. On the 8th of September this office received from Dr. Russel a colony of Asiatic ladybirds. In the absence of suitable tubes the Doctor made ingenious use of ordinary lamp chimneys. These he filled with food for the ladybirds and with it placed as many pupae and adults of the ladybirds as he could find.

* Reprint from the September, 1905, "Forester and Agriculturist."

In their turn the chimneys were packed in damp moss in a box and placed in cold storage on the "Mongolia." Of the lot sent three beetles and five pupae came through in excellent condition. A few days later the pupae reached maturity and subsequently the office was in the happy possession of five strong beetles. To the writer the care of these beetles was a lively treat, as he has had two years' experience with them at the U. S. Bureau of Entomology at Washington, whither this species was introduced to check the ravages of the notorious San Jose scale and where he has had such signal success in breeding it.

The preferred hosts of this ladybird in Japan and China are what is known in the States as the "peach scale" (*Diaspis pentagona*, Targ.), with the San Jose scale (*Aspidiotus perniciosus*, Coms.) as a close second. While both of these scale insects are reported from the Territory their abiding place was not definitely known. The entomologist in charge was, therefore, obliged to resort to experiment in order to determine whether the ladybird would adapt itself to some other scale insect that occurs in abundant numbers in the vicinity of the laboratory. Naturally, only closely allied species of scale insects could be depended upon to supply the pressing want,—food for the hungry. This was fortunately found in the rose scale (*Aulacaspis rosae*, Sandb.) which the beetles readily accepted as food and breeding environment. Ere very long eggs laid by the beetles were observed and a considerable number of these was subsequently brought to full maturity, and at this writing the second generation is getting a start in Hawaii nei. A couple of weeks ago, Mr. Austin reported the presence of the San Jose scale on some peach and plum trees at Mokuleia, Oahu, and infested twigs of these were used as food in the breeding jars with good success."* The beetle has the peculiar and interesting habit of withdrawing the scale insect from beneath its scaly dome and while munching it, fill the tenancy with an egg of its own. A full report of the habits of this ladybird appears in the 1902 Year Book of the U. S. Department of Agriculture, written and illustrated by C. L. Marlatt, the entomologist who introduced it into the States.

* See below note on the San Jose scale colony.

But let us not be misled in our hopes. While the beetle thrives on the rose scale in the laboratory, there is no telling what will be its fate when it is placed out of doors. Mr. Koebele has undoubtedly introduced the beetles into these Islands in the past, but no records are at hand to say whether they arrived in good condition and whether they were properly cared for upon arrival, nor have any specimens of the ladybirds been collected thus far. When the colony is sufficiently strong no effort will be spared to establish the insect in the Territory. Even if it does not prove a signal success it will doubtless prove useful in helping to check some scale insects, especially upon plants in yards not otherwise looked after.

“SCUTELLISTA” (*Scutellista cyanea*, Motsch).^o

This is the name of a steel blue, four-transparent-winged fly which has been imported into California from South Africa where it was discovered to be an effective check against the black scale (*Saissetia oleae*, Bern.). This scale has long been one of the worst pests in the citrus and olive orchards of California, but owing to the successful introduction and effective work of *Scutellista* the importance of this scale as a pest has ceased. Through the courtesy of Mr. E. M. Ehrhorn, the present Horticultural Inspector at San Francisco, a colony of this interesting parasite was received by Mr. Craw on the 25th of August. Most of the arrivals were in the pupa stage and the first dozen specimens that issued was released in and about Kapiolani Park upon Hibiscus infested with *Saissetia nigra*, Nietner. This scale was resorted to as food because *S. oleae* is exceedingly scarce in Honolulu. The parasites that issued subsequently were released upon potted Hibiscus plants infested with *S. nigra*, confined in a breeding cage. Thirty days later ample evidence of the establishment of this important parasite in Honolulu was to be observed upon the confined plants, as well as those in Kapiolani Park. The evidence consisted of the characteristic exit holes in the scales, and the numerous adults flying about in the cage. The success thus attained was gratifying indeed, and particularly interesting because it was accomplished by means of another species of scale insects, and

^o Reprint from October, 1905, “Forester and Agriculturist.”

because the life cycle was here completed in 30 days, some 17 days less than is required in California. This rapidity of development promises faster breeding and hence more effective work against the scale. Some of the plants in the breeding cage were transferred to Kapiolani Park and replaced by others and henceforth this Division will be in position to supply the parasites wherever they are wanted.

Hippodamia ambigua, *H. convergens*, and *Coccinella californica*.

A strong colony of these ladybirds was received from Mr. E. M. Ehrhorn of San Francisco on December 8, 1905. For the present they are being bred in the laboratory for subsequent distribution.

SIPHANTA EGG PARASITE (*Aphanomerus pusillus*, Perk.).^{*}

Aware of the economy of Siphanta on these Islands, Messrs. Koebele and Perkins while in Australia a year ago, were on the sharp lookout for its enemies, since the insect came to us from that country. On October 19, 1904, the "Miowera" brought among other things a tube that contained a good many egg batches of a species of Siphanta, from these gentlemen. A note of this accession appears in the November, 1904, number of the "Forester" (Vol. 1, p. 294). By the first of November, 1904, over a hundred specimens of the parasite were bred from those eggs and distributed in two Siphanta-infested centers on this Island. The parasites will be named and described[°] by Mr. Perkins in a bulletin soon to be published by the Hawaiian Sugar Planters' Association Experiment Station. It is a four-winged fly of an orange yellow body and dark head, whose entire life from egg to adult, is passed within the egg of Siphanta. On the 5th of last month the writer in company of Mr. David Haugh, the Forester's assistant, visited one of these colonies and to his delight discovered there both the fly and the tell-tale holes, evidence of its work. The good ally is thus happily established upon these Islands, and if its presence achieves what is hoped for, much good shall have been accomplished. The work of its distribution is now in order; some ten colonies have

^{*} Reprint from October, 1905, "Forester and Agriculturist."

[°] At the present writing the insect has been described and named as above.

been shipped to different points on this and other Islands. With the co-operation of our correspondents we hope soon to have it disseminated through all points where the *Siphanta* exists.

II. DISTRIBUTION OF BENEFICIAL INSECTS.

The following insects were distributed over the given Islands in course of the year. The list is presented here principally for the sake of record.

COLONIES OF BENEFICIAL INSECTS DISTRIBUTED DURING THE YEAR.

	Hawaii.	Maui.	Oahu.	Kauai.
<i>Siphanta</i> egg parasite (<i>Aphanomerus pusillus</i> , Perk.).....	9	2	3	..
Asiatic ladybird (<i>Chilocorus similis</i> , Rossi).....	1	..	2	..
<i>Chilocorus circumdatus</i> , Schon....	..	..	4	..
<i>Coccinella abdominalis</i> , Say.....	1	..	..	..
<i>C. repanda</i> , Thunb.....	1	..	7	..
<i>Coccinellidae</i> (Misc.).....	..	1	..	..
<i>Ceolophora pupillata</i> , Schon.....	1	1	6	..
<i>Cryptolaemus montrouzieri</i> , Muls..	1	1	12	..
<i>Siphanta</i> pupa parasite (<i>Dryinid</i>) ..	..	..	3	..
Dung beetle .....	..	..	2	..
<i>Fulgorids</i> (on "Dodder").....	..	..	1	..
Jap. Beetle Fungus.....	2	2	36	3
<i>Braconid</i> (Horn fly parasite)....	..	..	2	..
Lantana insects .....	..	..	..	1
<i>Leis conformis</i> , Boisd.....	..	..	4	..
<i>Norius cardinalis</i> , Muls.....	1	15	7	..
<i>Platymus lividigaster</i> , Muls.....	1	2	6	..
<i>Platymus</i> sp.....	1	1	1	..
<i>Rhizobius lophantae</i> , Blaisd.....	1	..	..	..
<i>R. ventralis</i> , Erickson.....	1	1	16	..
<i>Scutellista cyanica</i> , Motsch.....	..	..	2	..
Lantana leaf bug (<i>Teloneamia subfasciata</i> , Champ.).....	..	..	..	2
<i>Thalpochares</i> sp.....	..	..	1	..

A total of 164 colonies, of 24 species of insects; an aggregate of some 5000 specimens.

III. BREEDING AND STUDY OF ECONOMIC INSECTS ALREADY ESTABLISHED HERE.

In many instances the insects sent in by correspondents or collected by the office force were immature and had to be bred to maturity before their identity could be determined, since, with the exception of the "mealy-wing" or "white flies" (*Aleyrodidae*), insects could be definitely named only in the adult stage. Owing to the great abundance of parasitic insects one is not infrequently surprised by finding in the breeding jar the parasite instead of the host. In case of a parasite that confines itself to a single species of host the latter could be determined by the identity of the former. In the majority of parasites thus far bred, however, they are not confined to a single species of host, in which case, in order to determine the particular host under investigation a repetition of breeding becomes necessary. This question will appear in more tangible form in the appended paper on the horn fly parasite.

USEFUL INSECTS.

A determined effort was made to investigate the lantana insects. This investigation is not yet complete, but a preliminary paper on these was read before the Hawaiian Stock Breeders' Association at their annual meeting on December 18, 1905, and is submitted herewith.

PRELIMINARY NOTES ON LANTANA INSECTS IN HAWAII.

LANTANA SEED FLY (*Agromyzid*).

Of the lantana insects introduced into Hawaii by Mr. Albert Koebele several years ago, those that were established are now the most common lantana insects throughout these Islands. By far the most important of them, as it is also the most active and abundant, is the small black fly (Fig. 3), the maggots of which live in and destroy the seed. Favored by climatic conditions and abundance of food, and unchecked

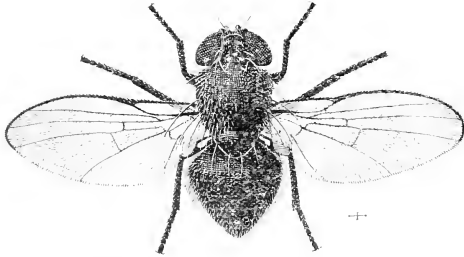


FIG. 3.—Lantana seed fly (Agromyzid). Hair line shows natural size.
(Author's illustration).

by its natural enemies, this fly has increased enormously since its introduction. In course of the past year it was difficult to find a lantana seed that was not either entirely destroyed or seriously damaged by this fly. Such complete destruction of lantana seed means that the plant can no longer be sown broadcast as was done formerly by mynah birds and doves. While in Makawao, Maui, last May, I was told by a farmer that owing to the absence of lantana seed the mynah birds have deserted the locality, as a result of which the Army-worm (*Heliophila unipuncta*, Haw.) was more destructive that spring than it had been for the previous twenty years. It may possibly be, however, that the drought was the principal cause of the migration. The fact remains that a stage has been reached in the fight with lantana when a field once thoroughly cleared of it may be depended upon to remain so indefinitely. We must hope now that fields cleared of lantana are not overrun by guava, which I was assured by growers of Kona, is far more difficult and expensive to eradicate. We must bear in mind, however, that there will always be times and places, when and where, after a complete extermination of lantana seed, the flies will die out for want of food, and then the seed is likely to get the start of the fly and some germinable seed will be produced before the fly has again increased sufficiently to check it. These ups and downs of host and parasite are a common phenomenon in nature and are to be expected.

But even should the lantana fly diminish in numbers for reasons just given we need have little fear of a large production of lantana seed, for we have at least three* other insects, moths and butterflies (*Lepidoptera*), which so mutilate the flower head and flowers that very little, if any seed is formed. These accomplish their task in the caterpillar stage.

LANTANA FLOWER INSECTS.

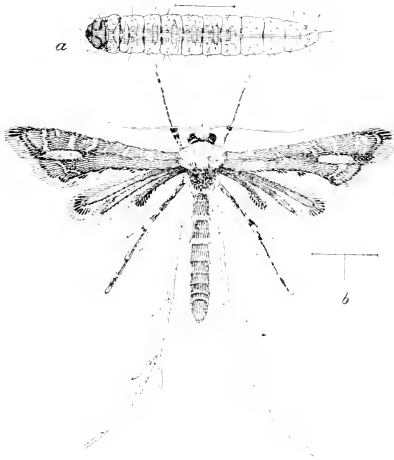


FIG. 4.—Lantana Plume-moth (*Pterophoridae*): *a*, larva; *b*, adult. Hair lines show natural size. (Author's illustration).

Lantana Plume-moth (*Pterophoridae*).

This is the dark brown moth (Fig. 4, *b*) about half an inch in expanse and one-half as long. It seems to lay its egg either at the base of the individual flower or slightly above. Upon hatching, in the former case, the young caterpillar excavates a tunnel under the flower; in the latter it gnaws a hole through the corolla, attacks and destroys the pistil, then descends be-

* These may actually represent four or more species. Thus far the Tingid (*Teleonemia subfasciata*) is the only species of the introduced lantana insects that has been definitely identified.

neath the flower and continues to feed in the torus (flower-bearing head). By the time it is full grown many of the flowers are destroyed and the torus is an empty shell. Preparatory to pupation it weaves together by means of silken threads the remnants of the dead flowers and eloses the entrance with the bundle thus made. It then pupates in which state it remains about two weeks, after which it emerges as a perfect moth.

The larva (Fig. 4, *a*) is opaque, greyish white, with the exception of the head, thoracic shield and true legs which are shiny brownish black. In life the head is retractile into thoracic shield; pro-legs on abdominal segments 3-6 and 9.

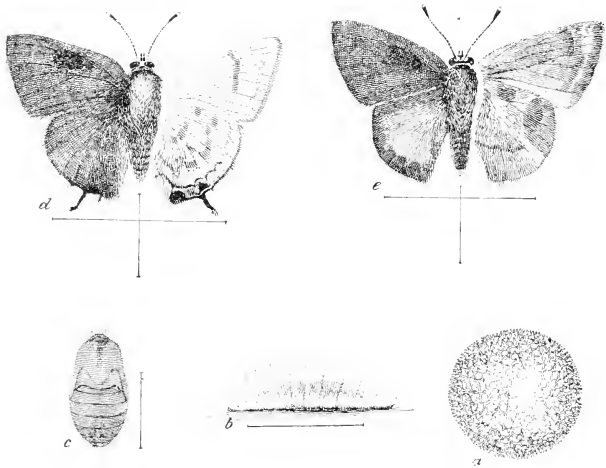


FIG. 5.—Lantana Butterflies: *a*, egg; *b*, larva; *c*, pupa; *d*, adult (bred from *a*, *b*, *c*); *e* another butterfly. Adults show marking of upper and under sides of wings. Hair lines show natural size of all, but egg which is $\times 30$. (Author's illustration.)

Lantana Butterflies (*Lycacnidae*).

One of these is a pretty, small butterfly, with upper side of hind wings metallic blue, the rest of the insect being mottled brownish gray (Fig. 5, *e*). It lays its egg (Fig. 5, *a*) upon the young lantana flower and the subsequent caterpillar feeds upon

the flowers and young seed. The other differs somewhat in color, but its work is identical with the first. The caterpillars of both are variably green in color, fuzzy, short and stubby, varying in length from $\frac{1}{4}$ to $\frac{1}{2}$ an inch when full grown, and about $\frac{1}{2}$ as wide (Fig. 3 *b*). Their identity has not been ascertained, but their work is so similar in appearance that for our purpose this meagre description will answer, at least for the present. The three caterpillars are so abundant at present that no flower is without one or both of them, and more frequently several specimens of each infest a single flower head. Especially is this true of flowers at lower elevations, so that there the chances for the production of seed are very poor indeed.

LANTANA LEAF INSECTS.

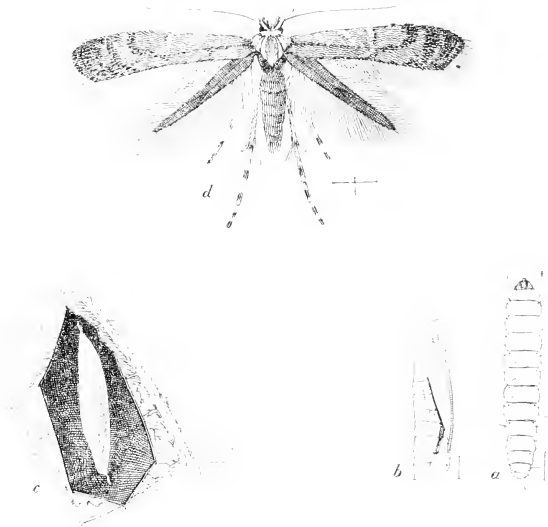


FIG. 6.—Lantana leaf miner. *a*, larva; *b*, pupa; *c*, cocoon, containing pupa, in situ; *d*, adult. Hair lines show natural size. (Author's illustration).

“Lantana Leaf-Miner.”

(*Lithocolletis* sp.).

This caterpillar (Fig. 6, *a*) when full grown is pale yellowish-white, with a yellow streak through the middle, representing some internal organ, doubtless the silk glands which produce the cocoon; the entire insect with the exception of the mouth parts and legs, which are brownish, is translucent and tapers slightly posteriorly; the segments are very distinct; occasionally the darker pellets of excreta are seen through the body wall. This caterpillar attains full growth within the mine and there transforms into a pupa (Fig. 6, *b*). The pupa is enclosed within a very pretty, white, longitudinally ribbed sack (Fig. 6, *c*). It seems that before commencing to build this sack the caterpillar gathers all its frass into a small space and covers it with a net-work of silk, evidently to protect itself from the effects of decay. The sack contains the inactive stage of the insect and is usually found in older, somewhat dried mines and is so conspicuous that it is not overlooked even by the layman. The tiny gilt colored, striped legged moth (Fig. 6, *d*) is the outcome of this useful miner. One of these mines (Fig. 6, *c*) is not sufficient to destroy a leaf, but as they usually occur in large numbers, up to six or more in some cases, it is inevitable that the vitality of the leaf should be materially reduced.

“Lantana Leaf Bug” (*Telconemia subfasciata*, Champ.).

Another insect that has inflicted terrible injury upon lantana is a small Tingid bug (Fig. 7) which should be popularly known as the “lantana leaf bug.” It is a true bug belonging to an order of insects (*Hemiptera-Heteroptera*) supplied with jointed beaks, capable of taking up liquid food only. Although introduced at the same time that the others were, it has not, until the past year I believe, increased to such large numbers as have the others. It may possibly be that the unusual drought of the year has been particularly favorable for this enormous increase. Large numbers of it, particularly the younger stages, occur on the under surface of leaves, and together with

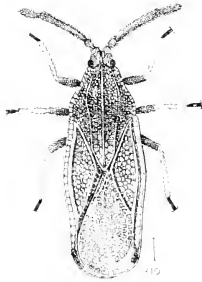


FIG. 7.—Lantana leaf bug (*Telamona subfasciata* Chiam p.)
Hair line shows natural size
(Author's illustration.)

the leaf miner referred to above, and the drought, they have defoliated lantana two or three times in course of the year. To all appearances, particularly on the leeward side of hills and Islands, lantana was dead. This was only an illusion, however, which was quickly removed either by careful examination of the stem or by the reappearance of foliage after heavy rains. The younger shoots of lantana were usually found dead. There is no doubt that during the last year lantana received severe injury and a quite serious set-back.

These "leaf bugs" were so abundant everywhere that it was inevitable that some of them should stray to other plants, either of their own accord, or blown by the wind. Their leisurely, deliberate mode of locomotion makes them an object of easy study. As a result of these facts many people have repeatedly observed the insect on plants other than lantana and, warned by previous experiences, have repeatedly attempted to raise the alarm of a new pest. The fact is, however, that although it does occur on plants other than lantana, it has never been observed to breed upon them or in sufficient numbers to do injury; neither has it been observed in the actual process of feeding on plants other than lantana.* So that no apprehension on the score of these insects need be entertained. Close watching, however, does no harm.

* See my note in the Hawaiian Forester and Agriculturist, Vol. II, pp. 401-2.

While the leaf insects kill the young shoots of lantana they are also, though indirectly, responsible for the periodical heavy crop of lantana flowers. It is a well known fact that plants and animals are most prolific when their chances for life are reduced. This phenomenon is accounted for by the law of perpetuation of the species, i. e., every living being feels the instinctive impulse of helping to perpetuate its kind and, when disease or want of nourishment threatens its existence it turns all of its available vitality toward reproduction. Fruit trees upon a deserted farm where they are neither fed nor otherwise attended to are known to produce heavier crops of fruit than their neighbors, upon an adjoining lot perhaps, living in opulence. In order to hasten the flowering of a plant horticulturists take advantage of this indomitable law and either root-trim those plants severely or plant them in small receptacles. To return to lantana we see that no sooner is a crop of leaves produced than it is immediately stripped. The repeated defoliation evidently so shocks the plant that it feels in danger of extermination. To save itself from such a calamity it concentrates all its available vitality upon reproduction. The plant, of course, does not reason but it does follow out the course laid down for it by nature. This overproduction of flowers is in itself therefore, an indication that the plant is suffering. As to the seed crop, I believe that our flower and seed insects will permit but little of it to mature. To all appearances lantana looks now practically doomed. Very few lantana plants are as healthy and vigorous today as they used to be.

The introduction of insects to check the spread of a plant has, to my knowledge, never before been tried anywhere in the world. Mr. Koebele is the pioneer worker in this line and judging by the marvelous results already attained, the credit to which he is entitled for what he has accomplished cannot be given him in more adequate form than by pointing out the difference between lantana on Hawaii as it was and as it is at present. He is moreover to be congratulated on the strict business-like manner in which these insects confine their work to lantana.

Lantana Scale or "Maui Blight"

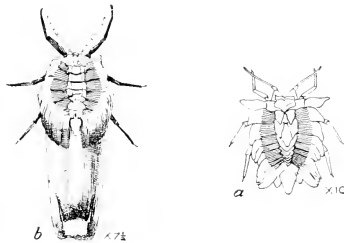
(Orthezia insignis, Dougl.)

FIG. 8.—Lantana scale or "Maui Blight" (*Orthezia insignis*, Dougl.): *a*, young; *b*, adult female. Magnification indicated by figures. (Author's illustration).

This lantana enemy (Fig. 8) was not introduced by Mr. Koebele. In fact in an exhaustive paper published in the "1902 Reports of The Commissioner of Agriculture," he warned the people most emphatically against its distribution. Despite this warning ranchmen have been scattering lantana infested with this scale all over the Islands. Only in a few localities does it seem to spread rapidly, but, wherever it exists, it surely assists in reducing the vitality of the lantana giant. Fortunately this insect has not yet been observed in injurious numbers on any plant of economic importance, if we disregard the ornamental plants. At Wailuku, Maui, it has been observed by the writer to have practically destroyed a *Gardenia*, and at Ulupalakua, Maui, Mr. Eli Snyder called attention to serious infestation of *Alternanthera*, *Coleus* and *Achyranthes* by this scale bug. Where the insect will stop it is impossible to say. Its adaptability to plants other than lantana on these Islands it has shown. "A hint to the wise is sufficient."

A similar study of the horn fly and its parasites was made. The following notes on the subject were presented to the same Association.

HORN FLY AND ITS PARASITES IN HAWAII.

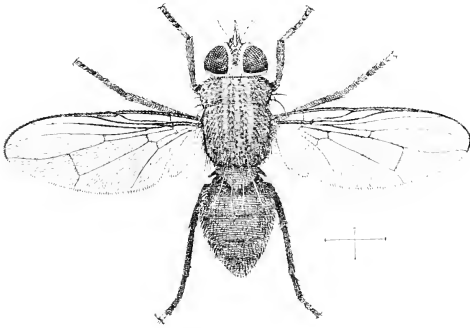


FIG. 9.—Horn fly (*Hamatobia irritata* R. D.). Hair lines show natural size. (Author's illustration.)

From Dipterous (two-wing flies) pupae collected in horse dung at Volcano House, Hawaii, about June, 1905, Mr. F. W. Terry, of the Planters' Experiment Station Staff, bred parasites which upon subsequent examination proved to represent two species of *Spalangia* (*S. hirta*, Haliday, and *S. lanaiensis*, Ashm.), both recorded in the Fauna Hawaiiensis. The first of these (Fig. 10, *b*) was collected years ago in Honolulu by Rev. T. Blackburn, while the latter (Fig. 10, *a*) was found by

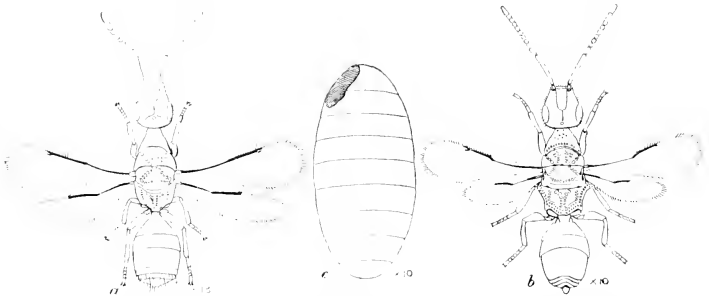


FIG. 10.—Horn fly parasites: *a*, *Spalangia lanaiensis* Ashm.; *b*, *S. hirta*, Haliday; *c*, horn fly pupa showing exit hole of parasite, \times figures indicate magnification. (Author's illustration.)

Mr. R. C. L. Perkins on Lanai, and described in the Fauna as new. Mr. Terry kindly brought my attention to these parasites and offered to coöperate with me in whatever experiments I might choose to undertake, and my thanks are due him for assistance in this work. The two questions that presented themselves at this stage of the work, were (1) whether either of these parasites attacks horn fly (*Haematobia serrata*, R. D.) pupae, and if so (2), whether they occur on all these Islands; if not, they should be bred and distributed.

To determine the first point horn fly pupae were collected and placed in tubes containing active fecundated females of *S. hirta* (the other species had died out) and watched carefully. The horn fly pupae were attacked promptly and stung repeatedly, although the parasites were originally bred from pupae of the stable fly (*Stomoxys calcitrans*, Linn.). In about three or four weeks the parasites issued successfully from these pupae, thus demonstrating the possible usefulness of the parasite. Subsequent field study corroborated the laboratory work. While searching for horn fly pupae at a Palolo dairy one of the parasitic flies was observed walking about within the dung heap. It was captured and its identity with the survivors from the Volcano House established. It was also bred from pupae collected in that dairy. Horn fly pupae collected at Leilehua, Oahu, on August 1, 1905, were also found to be inhabited by *S. hirta*. Further examination disclosed that *S. laniensis*, the supposed native species, was bred from Dipterous pupae collected in Honolulu sometime last April. These facts demonstrated conclusively that these parasitic flies attack horn fly. The distribution and effectiveness of the parasites remained to be determined. In order to gain this information it was necessary to enlist the assistance of the ranch managers. After consulting the Secretary of the Stock Breeders' Association, a circular was sent out to all the ranch managers. Following is a copy of that letter:

LETTER TO RANCH MANAGERS.

Honolulu, October 22, 1905.

Dear Sir:—In our studies of the horn fly we have bred a parasite from its pupae collected on four ranches upon these

Islands. We are now anxious to determine the extent of distribution that useful parasite has attained. You can assist us in the determination of this important fact by collecting and mailing to us a lot of the horn fly pupae. These should be collected upon portions of the ranch differing in climate and altitude, kept separate and each parcel labeled indicating these conditions. This pupa, which is about one-twelfth of an inch wide and about twice as long, and dark brown in color, is usually to be found on the inside of the crust of droppings about three or four days old.

At the conclusion of breeding we shall be glad to report results.

Yours truly,

JACOB KOTINSKY,

Assistant Entomologist.

In response to this appeal for assistance but one man, Mr. D. T. Fleming, of the Maui Agricultural Company, sent specimens. It is true that correspondents on Kauai and Molokai also sent material, but those were replies to special requests. My thanks are due these gentlemen for the assistance rendered. Notwithstanding the meagre coöperation on the part of ranch managers, it was ascertained that at least the European horn fly parasite (*S. hirta*) exists on the five larger Islands, and that the native (?) species (*S. lauiensis*) occurs on Hawaii, Lanai and Oahu. Moreover, about 75% of the pupae received from Molokai were parasitized. In conversation, Dr. V. A. Nörsgaard, the Territorial Veterinarian, informs me that the parasite is responsible for considerable reduction of the pest at some seasons of the year, and it is evident that it is some check upon the horn fly at all times.

While on a visit to Kona last November the ranchmen there complained bitterly of the horn fly, yet when search was made for the pupae only three were found in the course of two hours. This may be explained either by the particular locality or the season, or both.

Any ranch manager might determine for himself whether or not the parasite exists on his ranch. It is presumed that he is familiar with the appearance of the fly and its pupae.

If he is not, it is to his interest to make their acquaintance. Collect pupae and place in a glass jar covered with a bit of cloth held fast by string or rubber band. At the end of a week or two flies will begin to issue, and if these are small, black, *four-winged*, he may rest assured that he has the parasite. The Entomological Division of the Board of Agriculture and Forestry is at any time ready to breed, determine, and report upon any material submitted for examination.

About February, 1905, a collection of dung fly larvae and pupae were received from Mr. Albert Koebele, who collected them near Sydney, New South Wales, and about March parasites began to issue from them. Two strong colonies of these were released; one near Honolulu and the other on Leilehua. Subsequent examination of horn fly material collected at both places failed to show the presence of the parasite. The same is true of a number of dung beetles or tumble bugs sent by Mr. Albert Koebele. None have been seen since the day of their release.

SCALE INSECT PARASITES.

The parasites affecting the numerous scale insects upon these Islands were bred extensively. In course of the coming year the writer hopes to be in a position to prepare and publish a monograph of the Coccidae on these Islands, together with a list and description of the parasites affecting them, which Mr. R. C. L. Perkins, of the Hawaiian Sugar Planters' Association Experiment Station, promises to prepare.

IV. OFFICE AND LABORATORY WORK.

IDENTIFICATION OF INSECTS.

This is an essential part of the office work. It is work that consumes a great deal of time, although there is little to show for it. While some insects are recognized at first sight the identification of others frequently takes hours and days of search through literature and comparison with descriptions and specimens. This is unavoidable, however, for the identity of an insect is the inevitable guide in the information to be given the applicant. We must also take stock, as it were, of

the insects occurring in the Territory in order to be posted on our enemies and friends. Frequently we are also called upon to determine the identity of an insect upon plants undergoing inspection. Great accuracy is a requisite of this work, since of two closely allied species of insects one may be already established on these Islands, and the other not yet, and, depending upon which of these infests the plant under investigation, the consignment is either admitted after fumigation or destroyed. So far as possible identifications were made in the office. With our equipment of laboratory, library and collections, this was possible in the case of many insects, particularly Coccidae. For assistance in naming insects in other groups the thanks of the office are due to Messrs. R. C. L. Perkins and G. W. Kirkaldy, of the Hawaiian Sugar Planters' Association Experiment Station; to Dr. L. O. Howard, Chief of the U. S. Bureau of Entomology, and his assistants at Washington; and to Dr. W. H. Ashmead and Mr. A. N. Caudell of the U. S. National Museum.

A number of species of Coccidae and Hymenopterous parasites, some of them new to science, were discovered in addition to the published lists. As stated before, it is hoped soon to publish a complete list of both these important groups. As related in a report to the Board, printed below, one very dangerous scale insect was discovered on Hawaii and it is believed, eradicated.

ARRANGEMENT OF COLLECTIONS.

As pointed out in last year's report this work is absolutely necessary in an entomological laboratory. As scale insects (Coccidae) are an important element in the economic insect fauna of this Territory, a special case was provided for our collection of these. A cabinet was also built to contain our main collection of insects. Whenever time permitted this work was carried on. The collection is increasing as fast as it could be taken care of and soon will be a fair representative of our economic insect fauna.

SELECTION AND PURCHASE OF BOOKS, APPARATUS AND SUPPLIES.

Books.

This was no easy task, as some works are scarce, and many second hand book catalogues have to be perused, carefully sifted, and much correspondence carried on before they are finally procured. A number of valuable additions to the library were made during the year. Some of these were purchased, others secured by exchange, and still others, notably an almost complete set of Tr. N. Z. Inst., were rediscovered among the old "Government Library" books, and with the aid of the Board and the Governor deposited on our shelves.

Apparatus and Supplies.

First class compound and dissecting microscopes, (one of each) were purchased and used to great advantage. It is absolutely impossible to work on scale and many other insects without these apparatus. A number of minor additions to the laboratory equipment were made, which though small, were indispensable.

VISITORS.

No record of these was kept until recently and even now it seems almost impossible to have a complete record. Generally speaking the office is almost daily visited by people of the Territory and much time is consumed in giving desired information. In a way these visitors take the place of correspondence, and many people prefer to call in person.

V. VISITS TO OTHER ISLANDS.

A necessary supplement in work as carried on by this office is personal contact with the individuals for whose benefit we are here installed. Such contact brings mutual understanding and appreciation and the co-operation of the agriculturists of the Islands, so essential for effective work. Both scientist and farmer are highly benefited by meeting in each other's

headquarters. With these objects in view a tour of the Islands by an entomologist was decided upon by the Board.

KOHALA, HAWAII.

On May 16, 1905, I sailed for Mahukona, Hawaii. Through the courtesy of Dr. B. D. Bond, I was domiciled at his house as long as I remained in this district. The "coffee scale" (*Pulvinaria psidii*, Mask.) was found there very abundant on the under side of leaves of birdnest ferns, but most of them were pierced by as many as four or five holes, the work of two internal parasites, (*Microterys flavus*, How., and an undetermined sp.), both of which were observed in active operation. A study of the mango fruit was made but no insects were found affecting the healthy fruit. The mango flower and fruit disease was in ample evidence. So was also the ubiquitous Avocado pear scale (*Pseudococcus nipae*, Mask.). Practically all of the insect pests observed here were of a nature that could be easily controlled, but the owners of the affected plants are generally too busy with other things, so that the plants and insects are practically abandoned to fight their own battles.

One morning was spent in company of Dr. Bond in his forest composed principally of Eucalyptus and Black Wattle trees. The latter were evidently suffering from injury by Fuller's rose beetle or "Olinda bug" (*Aramigus fulleri*, Horn.), of which there were groups of immense numbers clustered on the under side of leaves and branches. In the afternoon a visit was paid to one of the homesteads in the neighborhood, but not much of a show was found in either the plant or animal life.

LAHAINA, MAUI.

Taking the return "Kinau" I landed at Lahaina, where among others, the Lahainaluna School and the premises of the Horners' were visited. At the latter place it was delightful to find a good lime orchard in excellent condition. The care of this orchard is supervised by Mrs. Decoto, who told me that the orchard has always yielded profit despite the presence of

the "purple scale" and other citrus pests. It appears that Mr. Koebele stopped at the house some time ago and at his suggestion the lady secured a spraying outfit which she has employed to good advantage. The trees looked well trimmed and the soil between them in good state of cultivation. This was an excellent demonstration of what could be accomplished in citrus culture on these Islands when intelligence is applied.

WAILUKU, MAUI.

That very day I took stage for Wailuku and the following day was profitably invested interviewing persons taking prominent interest in matters agricultural and in studying the insect problems of the place. The most striking feature to an entomologist about Wailuku is the blackness of the lantana. This is due to the presence of the lantana scale insect (*Orthezia insignis*, Dougl.) which was first observed there. It was interesting to note that the lantana in the vicinity of where the scale bug was first discovered is alive at present, although blackened and injured. Moreover, as noted on another page, here was my first experience on these Islands to find lantana scale in injurious numbers upon a plant other than lantana. Otherwise the insects affecting plants commonly cultivated on these Islands did not much differ from those we are accustomed to see in and about Honolulu.

KAHULUI AND PUUNENE, MAUI.

The following morning I took train for Kahului where I had the pleasure of meeting Mr. Filler, who informed me that to his knowledge and belief no fruits or plants entered the port of Kahului without a previous inspection by the entomologist in Honolulu. The courtesy of a visit to Puunene, which I had the pleasure of making in the company of the Hon. H. P. Baldwin, was extended to me. There I was greeted by an interesting entomological problem. The Casuarina shade trees lining the streets and all the citrus trees upon the premises were dying from the effects of "cottony cushion scale" (*Icerya purchasi*, Mask.), with which they were thickly infested. This, notwithstanding the fact that only two or three

months previous to that a strong colony of *Vedalia* (*Norius cardinalis*) was released there. It was also noted that a Casuarina within a yard where it had evidently received good attention was practically free of the pest although the tree across the way was dying. I was forced to conclude that the prevailing drought was responsible for the state of affairs and this conclusion was confirmed when I was informed that in all probability owing to the drought no water was available for these shade trees. Of this incident you were informed at the time, as I used my letters in place of a report,—in other words, instead of noting down my observations and then copy them into report form, I wrote them down in the letter to you at the end of each convenient day.

MAKAWAO, MAUI.

By rail and hack I reached Makawao towards evening of the same day. Mr. W. O. Aiken, the honorary entomological inspector of the Board, with whom I stayed part of the time spent in Makawao, had been crippled by an accident and was, therefore, not in a position to give me much information on the imports at Kahului. In company of Mr. Jas. Lindsay of Haiku, I went up to Kailili, where the day was very profitably spent with him and Mr. W. Hannestad, in a necessarily brief survey of insect depredations in the Koa forests. The following day was spent again in company of Mr. Lindsay in an examination of insects affecting pineapple, sisal, citrus and peach trees. The pineapple in places was found thickly infested with a pineapple scale (*Aulacaspis bromeliacae*, Kern.) and with more or less mealy bug (*Pseudococcus* sp.). The trees showed evidence of neglect and perhaps the worst pest of the place is "Oi" (*Verbinaccac?*). This wiry weed constitutes a serious problem in the sisal field there. Siphanta was very abundant, especially on tender shoots of mango trees. Ripening mangoes suffered severely from fungus. Mr. D. D. Baldwin claimed to have reared a moth, the caterpillar of which was injuring mango blossoms. Unfortunately his specimens were not preserved. Here I demonstrated to satisfaction that the side of the tree and fruit exposed to the sun is least affected by the disease.

On my way to Kula I spent a few most interesting hours of the next day with Mr. E. H. Bailey. This gentleman is undoubtedly the most typical modern American farmer upon these Islands. Well equipped with an agricultural education he grows most successfully wheat, barley, speltz grass, potatoes, corn, melons, pumpkins, etc., etc. There was an excellent stand of each of these, notwithstanding the cut-worm, melon fly, potato rot, aphid and army worm that were devastating adjacent fields. The secret of his success lies, generally speaking, in a thorough knowledge and understanding of the science of agriculture. Specifically speaking, he feeds and cultivates his plants thoroughly and makes good use of appropriate insecticides. He has no difficulty, he claims, of disposing of his products on the Island of Maui to advantage, thus saving cost of distant transportation. His is beyond doubt a model farm, and this is more strongly emphasized by the strong tendency among the neighboring Japanese and Portuguese to imitate him. To an American it was a treat to see Mr. Bailey's farm. I was shown a pile of about 1700 pounds of potatoes of uniform, large size. These constituted the first half of a crop obtained from 160 pounds of potatoes planted in season.

Haleakala Ranch, by courtesy of Mr. L. von Tempsky was the next stopping place. The time spent upon this ranch was rather short, and horn fly in numbers was the only insect to attract attention. Mr. von Tempsky also complained of the ravages of aphid on corn. The following day was spent at the ranch of Mrs. Dora von Tempsky in Kula. It rained rather hard the evening of my arrival, but a trip to the native forest was made nevertheless. Fuller's rose beetle or "Olinda bug" was here in evidence, so was the "greedy scale" (*Aspidiotus rapax*, Comst.). The latter was very thick on young koa (*Acacia Koa*) and lehua, but there was also evidence that the original destroyers of the native forest are roaming cattle. The older trees when injured are immediately seized upon by various insect pests, native and introduced, which kill them in a short time, and the young trees, while they make strenuous efforts to replace the old ones by springing up in clumps here and there and everywhere, are so

mutilated and chewed up by cattle that they do not see the light of many days.

ULUPALAKUA, MAUI.

The ranch of Dr. J. H. Raymond was the next center of attraction. Along the road to this place one could not help being pained by the sight of thousands of ghosts of what were once elegant native trees. The lantana belt, which was struck in course of the descent, was interesting in that vast fields of the plant were evidently dead, killed apparently by the lantana scale. The entire area bore the characteristic black appearance. The original owner of Ulupalakua evidently lavished much money and thought upon the embellishment of the neighborhood. It was delightful to see every hill top crowned by forest trees. Perhaps the largest introduced shade trees upon these Islands grow at Ulupalakua. The numerous black wattles upon this place were found thickly plastered with cottony cushion scale, so much so, that the trees were actually dying from exhaustion. What was more surprising was the fact that not a Vedralia was to be found here, although a colony, I was informed, was released but a short time previous. Through the courtesy of Mrs. Raymond, a place some three miles away was visited, and a small leguminous plant, useful I was told as a pasture, was found infested with the same scale. The condition seemed serious enough to warrant sending a wireless asking for a shipment of a series of colonies of the ladybird. The manienie grass (*Cyudou dactylou*) was also found badly infested by an apparently new species of mealy bug.

HILO, OLAH, VOLCANO HOUSE AND KAU, HAWAII.

I reached Hilo on the last of May towards evening, and most of the next day was spent with Bro. Matthias, who had a good deal of information to give on the economic insect fauna of the district. It is perhaps needless to say that it rained most of the time spent in the metropolis of the Big Island.

The second and third of June was spent at Mountain View, principally on the estate of Dr. Russel. During these two days it rained there almost constantly so that little observation

to advantage could be made, else the locality would have received a more thorough study. The citrus plants there did not look healthy and yet the principal cause of this condition seems to have been the nature of the sub-soil which has been ascertained to contain a compound of iron (Ferrous sulphate) inimical to vegetation, as a result of which the roots instead of penetrating it remain in the surface soil. This soil is very porous and because of the great rainfall does not hold whatever plant nourishment becomes available either through natural causes or artificial application. A caterpillar, the identity of which has not been ascertained, seems to do more or less injury to the citrus blossoms. Purple scale is quite thick, although the fungus attacking it (*Sphaerostilbe coccophila*, Tul.), which has been imported from Florida, is also thriving. The citrus plants seem also damaged somewhat by snails and not a little perhaps by lichens. Here as in Kohala, every bit of arboreal or bush vegetation, dead or alive, is thickly plastered with lichens from top to bottom. Quite young plants look hoary with age because of the lichen blanket. Lichens, while not injurious directly, probably do more or less damage to plants they cover by excluding sunlight and air. Siphanta was plentiful with results similar to those given for other places.

Volcano House was the next stop. The management of the hotel maintains quite an extensive vegetable garden, the products of which are relished by their visitors. Large celery beds are a feature of this garden and much of this vegetable raised there is sold to advantage in Honolulu. The gardener complained most of cut worms and perhaps next in importance is a combination of aphids and fungus that afflicts celery. He was instructed to use poisoned bran mash against the cut worms and strong soap suds against the aphids. What seemed most remarkable at this place was the fact that ferns were observed sprouting up in cracks of lava which, I was informed by the guide, is of the 1896 flow. This would seem to indicate a very remarkable fertility of the rock.

By the courtesy of Mr. Julian Monsarrat, Kapapala Ranch was the next eighteen hour stop. What seemed to me like an oasis in the desert was the garden surrounding Mr. Mon-

sarrat's house in Kau. The Japanese beetle being the first topic, we dug about the bases of roses and were encouraged to find beetles dead with fungus in great abundance. This Mr. Monsarrat told me was the result of a colony of fungus we sent him some time previous. An undetermined caterpillar was found devouring the beet leaves. A taro patch in the vicinity was visited where the plants were suffering from aphids infesting the leaves. This aphid was not found as abundant as it seems to have been during the drought, still the young plants were quite thickly inhabited by the pest. But upon each leaf there was an average of about eight to ten Hemerobiid larvae voraciously feeding on the aphids. This was a revelation to Mr. Monsarrat and he felt fully compensated for my visit. There is apparently no lantana in Kau, but its place is taken by the scarcely less pernicious *Oi*. Mr. Monsarrat showed me a patch of this weed that seemed to be dying out which he thought was due to lantana insects sent him by Mr. Perkins some two years ago, but I could find no evidence of either the insects or their work. Red spider, however, was thick on the leaves which might account for the defoliation. The fungus on mango was in evidence and among the blossoms was a caterpillar of unknown identity. By stage from Pahala to Honuapo and by the "Manna Loa" from there I reached Hookena on the evening of June 7th.

HOOKENA, HAWAII.

The night was spent with Mr. G. W. McDougall and the next morning a study of the coffee trees in his charge was made. Mr. McDougall's attention had been called by Mr. John Gasper of Napoopoo to the prevalence of a caterpillar in the coffee berry clumps. This caterpillar was found on Mr. McDougall's coffee trees in considerable numbers, though in no case was positive evidence found to show that the insect was actually injurious. No freshly nibbled spots were to be seen either upon the young twigs or the berries. On rare occasions a berry was found into which a caterpillar had burrowed, but this insect was quite different from the twig caterpillar. It is probable, therefore, that the caterpillar was feeding upon

“mealy bugs,” which quite frequently seek shelter amongst the coffee berries. In addition thereto, that very useful parasite, *Chalcis obscurata*, Walk., was found literally swarming about the trees, and though it was not observed in the act of oviposition, there is no doubt but that it was there in quest of this caterpillar as host. There was absolutely no other insect upon the coffee trees to account for this abundance of a parasite about them. It was at the door of the twig caterpillar that Mr. Gaspar laid the cause for the dropping off of a large portion of the newly set berries. After ascertaining the nature of the caterpillar I am inclined to believe that the heavy loss of berries was due primarily to the lack of cultivation of the coffee fields so affected. A not unimportant cause was also the unprecedented drought of the year preceding.

NAPOOPOO, HAWAII.

Most of the day following was spent with Mr. John Gaspar of Napoopoo. A survey of his coffee fields disclosed the fact that almost all of his coffee trees take care of themselves as best they can. The only attention they receive is that whatever berries they produce are picked off. Myriads of *Siphanta* swarmed everywhere. It is scarcely credible that they are not injurious, considering their numbers. The widespread havoc in coffee fields played by the fungus disease, for which *Siphanta* is held indirectly responsible, justifies strenuous efforts at checking the pest.

A mango tree was here found thickly inhabited by the black, beetle-like cockroach (*Eleutheroda dytiscoides*, Serv.). It has previously been known as destructive to Cypress and Citrus trees. Mr. Gaspar, the owner of this mango, had his chickens trained to follow him whenever he approached the tree and devour the roaches as fast as they were shaken to the ground. This method seemed so efficient that it was later suggested to others complaining of depredations of this pest.

Close by the residence of Mr. Gaspar is Mr. Bruner's pineapple field and cannery. The mealy bug, so common on this fruit wherever it is grown, was here found in abundance, but not enough to do material harm. The decayed spots on the fruit were found inhabited by the beetles (*Staphylinid* and

others) common in such places. Their injury being of a secondary nature it need not be feared. A vinegar fly (*Drosophila*, sp.) was a source of annoyance to Mr. Bruner at the mill, and he was advised to so dispose of the refuse that it dries as quickly as possible, thus destroying the breeding places for these flies.

KEALAKEKUA, AND BALANCE OF KONA, HAWAII.

The rest of the time was spent in a study of the insects on coffee, citrus and vanilla along the Government road of Kona.

The most abundant insect in all these fields was the Siphanta. The locality simply swarmed with them. Occasionally a branch of coffee was found overrun with coffee scale, though ever accompanied by that most useful little animal, the brown ladybird (*Cryptolacmus montrouzieri*). The parasites of this scale were also commonly observed. The most injurious pest in the coffee fields is fungus, beyond a doubt. Trees laden with the blackened berries of the previous crop were everywhere to be seen. I was informed that fully 25% of the coffee crop is ruined every year by this disease, and this in fields in an excellent state of cultivation.

Citrus plants were found afflicted with the usual retinue of scale bugs, including purple scale, Florida red scale, (*Chrysomplatus ficus aonidium*, Linn.), acuminate lecanium (*Coccus acuminatus*, Sign), etc. As there are no commercial orchards of these trees, none of them receive proper treatment, and the results are evidenced by unkempt, scraggy trees dying from sheer exhaustion.

While Siphanta was abundant in the vanilla gardens, it did not appear particularly harmful. A species of thrips in the flowers was complained of, and, worse still, some fungus disease occurring within the vine stems seemed to give the vanilla growers some concern.

Some casual observations on lantana were made. This plant was found infested with all its known insect pests except the leaf miner and lantana scale.

HUALALAI.

At the invitation of the Forester, R. S. Hosmer, who arrived at North Kona about that time, I accompanied him up the Kona slope of Hualalai to examine the insects affecting the trees on the proposed forest reservation. It was rather wet and cloudy most of the time spent up the mountain side. A fair collection of native insects was made, but none of them were found injurious to the prevailing vegetation. Nor were any of the noble Koas met there affected in any way.

NOVEMBER VISIT TO KONA.

The following letter from Mr. Craw, and copy of my report, reprinted from the December (1905) "Forester," fully expose the cause of the journey and its results:

LETTER OF MR. CRAW TO ENTOMOLOGICAL COMMITTEE.

Honolulu, October 28, 1905.

Hon. W. M. Giffard,

Chairman Entomological Committee,
Board of Commissioners of
Agriculture and Forestry,

Honolulu, T. H.

Dear Sir:—Among a number of specimens from a variety of plants received from Kealahkekua, Kona, on Wednesday last, we have found upon the leaves and bit of twig labelled "Giant lemon from Fiji," a number of scale insects of the species known in Ceylon as "Green bug" (*Coccus viridis*, Green).

This is the first time that the attention of any entomologist was brought to the existence of this dangerous insect upon these Islands. Mr. Green, the Government Entomologist of Ceylon, reports it as occurring there upon a large variety of plants, including Citrus, Gnava, Manihot (ceara and para), and last though not least important, upon coffee, both Liberian and Arabian. In a recent monograph of the species of this genus occurring in Ceylon, Mr. Green has the following to say regarding this species:

" 'Green bug' has proved such a scourge in Ceylon, being practically responsible for the final abandonment of coffee

cultivation over the greater part of the planting districts, that a short account of its origin and ravages must be added to the bare description given above.

Lecanium viride, popularly termed "Green bug," first attracted attention in Ceylon in the year 1882, when it was already doing considerable damage to coffee in the Matale district. The pest rapidly extended its area, and spread through all the districts of the Central province within three years. In 1886 it completed its conquest by appearing in the Badulla district, of the Province of Uva.....

Some idea of the collapse of the coffee industry may be obtained by comparing the annual export of coffee during the period of attack. In 1881, 452,000 cwts. were shipped from Ceylon. In 1891 this figure had fallen to 88,780 cwts. While, during the past year (1902), the total scarcely exceeded 10,000 cwt."

The insect has been reported from Ceylon, Brazil, Mauritius and West Africa. Mr. Green further reports that during the rainy season about 90 per cent of this scale is destroyed by a fungus disease described by Doctor A. Zimmerman, as *Cephalosporium lecanii*. In addition he mentions three hymenopterous parasites at work upon this scale in Ceylon, but these unfortunately "have their own natural enemies which keep them in check and prevent them from increasing in sufficient numbers to cope with the pest."

Under the given circumstances it becomes evident that an immediate examination is imperative. The origin of the scale, the extent of its distribution and the parasites at work upon it in Kona require immediate investigation. In view of the fact that the pest has been discovered in the very midst of our coffee industry, it is my opinion that no time should be lost, and active measures taken to exterminate, if possible, at least to check and prevent its spread into the coffee fields.

I propose to send Mr. Kotinsky by the next steamer sailing for Hawaii, to make the necessary investigation.

Awaiting your decision in the matter, I am,

Yours respectfully,

ALEXANDER CRAW,

Supt. of Entomology and Inspector.

REPORT OF MR. KOTINSKY ON VISIT TO KONA.*

Honolulu, T. H., November 29, 1905.

Mr. Alexander Craw,

Supt. of Entomology and Inspector of the
Board of Commissioners of
Agriculture and Forestry,
Honolulu, T. H.

Dear Sir:—In compliance with your commission of the 7th inst. wherein you direct me to proceed to Napoopoo, Hawaii, as early as possible and make a thorough examination into the origin, distribution, enemies, etc., of the "Green bug" (*Coccus viridis*, Green) recently discovered upon portions of plants coming from said locality, also to consult with growers regarding reported fungus disease upon vanilla plants in that district and render all possible assistance, I sailed for Napoopoo, Hawaii, on the noon of that very day, reaching my destination just 24 hours later. Early morning of the 14th inst. I returned from my mission and beg leave herewith to submit my report upon it:

GREEN BUG ON LEMON TREES AT HONAUNAU, SOUTH KONA,
HAWAII.

For reasons unknown some Kona residents have lately gained the impression that all vegetation there, including vanilla and coffee, the staples of the district, is suffering from what was supposed to be a single cause. All the real and imaginary damage was laid at the door of the lantana leaf bug (*Teleonemia subfasciata*, Champ.) usually referred to by local entomologists as the Tingid. In support of this theory the evidence was presented that this bug occurs upon all plants of the district and that the foliage is studded with specks which was presumed resulted from punctures by this insect. To determine this question definitely a collection of affected leaves was submitted to this office for examination. These were received on the 24th ult. and carefully studied. Among them were a couple of leaves and a bit of twig labeled "Giant lime (mistaken for lemon)

*Reprint from December, 1905, Forester and Agriculturist

from Fiji" thickly plastered with what we have definitely ascertained to be the above named scale insect. The author of this species reports it to have completed the destruction of the coffee industry in Ceylon in course of some 10-20 years. As but one or two of the numerous specimens received showed signs of having been parasitized and as the plants were located in the very midst of the coffee center on these Islands, and as moreover, the insect is known to infest also rubber, guava and other plants immediate action became imperative.

It was subsequently ascertained that three years ago this month a half dozen plants were imported from Fiji. While no scale was observed upon the leaves when collected for us, it was probably observed on previous occasions, but owing to its strong resemblance to immature coffee scale (*Pultrina psidii*, Mask.) its identity was not suspected. Other citrus plants were found growing upon the premises and it is fortunate that the Fiji lemons were considerably removed from them and surrounded by other vegetation. A careful examination of these plants revealed only two of the lot infested with green bug, the others being absolutely free from it. Some distance away was a lemon tree about twice the height of the Fiji specimens, origin unknown, quite thickly infested with both the coffee scale and green bug. A large number of the mature scales were killed by parasites, the exit of one of which was observed and the insect captured. Some material for breeding of parasites and the collection were saved, the trees themselves having been up-rooted and burned before I left the district. The third infested tree above referred to proved quite a puzzle for a while as it was suspected of having come from another resident of the district in which case Fiji, as the original source of the bug, was not altogether certain. A careful study of the vegetation on the premises of this other resident, however, dispelled the fear that the bug was generally scattered. I failed to find it there and furthermore established that the third infested plant did not come from there. With the object of ascertaining the possible distribution of the bug, all varieties of plants liable to infestation by it were examined all along some 16 miles of Government road in Kona, as well as the premises of the planters visited, but the insect was nowhere found.

The limited distribution of the insect may be accounted for by the probability that only a few specimens were imported originally in addition to which it was later kept in check by parasites affecting similar scales. I believe that with the destruction of those plants we have eliminated a dangerous pest and may consider ourselves fortunate in having nipped the evil in the bud.

FUNGUS DISEASES OF VANILLA, COFFEE AND OTHER VEGETATION IN KONA.

Having solved the green bug problem I was confronted with the necessity of allaying the peoples' apprehensions as to the future of vegetation in Kona. Vanilla seems to be suffering from a mysterious enemy to elucidate which it was necessary to become familiar with the history of the plant on Hawaii. This is given here briefly.

Some 15 years ago Mr. Edwards, who was then a Vanilla grower on the Seychelles, had the misfortune of having his entire Vanilla field devastated by a fungus disease described by Massee in the Kew Bulletin for 1892 as *Calospora vanillae*. Briefly, this fungus was described as passing through three distinct stages in course of its life cycle. The first of which, known as *Hainesia*, alone lives and propagates upon living Vanilla leaves; while the subsequent two, known as *Cytispora* and *Calospora*, do so only upon dying and dead Vanilla leaves. It is the spores of the last stage that germinate upon living leaves and produce the above *Hainesia* stage. It becomes evident from these facts that if all dead and decaying Vanilla leaves be burnt the fungus would be deprived of a medium of propagation and thus be either entirely eliminated or at least reduced to insignificance. But by the time this discovery was made it seems to have been too late to save the Vanilla field in the Seychelles. In a subsequent publication Massee reports to have identified this fungus upon Vanilla, also from Antigua and New Grenada. Some two years ago Mr. R. V. Woods, who is also an extensive Vanilla grower of Kona, observed some brown discoloration within the stems of his vines, from the effects of which a number of the vines were dying. Climatic and other conditions for Vanilla growing in Kona

seem so favorable that despite the presence of this stem disease, the vine continues to grow vigorously and rapidly until the disease breaks through the stem, when the entire plant succumbs. During a recent trip to London, Mr. Woods took some of the diseased stems over to Massee, who determined the trouble as identical with the one described from the Seychelles. The cuttings for all of the Vanilla grown in Kona were originally imported by Mr. Edwards from Fiji. Before starting Vanilla in Kona, Mr. Edwards had spent some two or three months on the Fiji Vanilla plantations, and according to his statement, has observed no disease existing there upon the vines. Had the Seychelles fungus been present there, he claims he should have recognized it without difficulty. He further claims that Massee's identification of the trouble prevailing in Mr. Wood's vines is wrong, as he is quite familiar with the manifestations of the Seychelles disease and does not recognize it upon the Kona vines. Mr. L. Lewton-Brain, a pathologist of the H. S. P. A. Experiment Station, who is familiar with Vanilla diseases in the British West Indies, and who kindly examined some of the diseased Kona vines, supports Mr. Edwards in his conviction that the brown stain of the stem, while a fungus disease, is not identical with *C. vanillae*. The writer's familiarity with the natural appearance of Vanilla vines and leaves is not sufficient authoritatively either to support or oppose Mr. Edwards' apprehensions concerning the prospects of Vanila in Kona. He, however, is inclined to regard them rather exaggerated. Perhaps because of his unfortunate experience with fungus diseases upon Coffee and Vanilla in former years, and possibly also prejudiced by the alarmist reports of some of his neighbors and by occasional defective Vanilla beans produced on his estate, Mr. Edwards has since his recent return from a visit to the Coast been scrutinizing vegetation much more minutely than he probably ever did before. As a result of this scrutiny he naturally finds very few perfect leaves on any plant. Those of us who have kept an observant eye upon life in nature are aware that owing to the thousand and one vicissitudes through which every portion of a plant and animal has to go before its mission is com-

plete, very few of them pass the ordeal unscathed. No doubt some fungus or fungi are at work upon *Vanilla* in Kona. Considering that *Vanilla* has been introduced into Hawaii from practically all its other homes and that no precaution against the introduction of its disease has been taken, it would have been surprising if none had been brought in.

RELATION OF LANTANA INSECTS TO OTHER VEGETATION.

Owing to the onslaught of the lantana insects introduced by Mr. Koebele, this plant presents a very pitiable aspect indeed, especially after a protracted drought upon the leeward side of hills and Islands. The Tingid above referred to has during the last year increased to such multitudes that beside occurring in large numbers upon each lantana leaf, is frequently observed, though in small numbers, upon vegetation in the vicinity, whither it is probably either blown by the wind or strays accidentally. Being so abundant the number of such accidental wanderings is naturally quite large. These accidents are probably as common to the lantana seed fly and the moth of the lantana leaf miner as they are with the Tingid, but the latter is an insect that moves about deliberately and does not fly away very readily, as do the other two, in consequence of which it remains longer under the observation of the layman. While the lantana seed fly undoubtedly occurs in vastly larger numbers than even the Tingid, yet the latter is much more frequently observed and is forming a stock in the layman's knowledge of insects. Under the circumstances it is natural that the Tingid should be regarded with suspicion by persons not otherwise informed. So far not one of the lantana insects introduced by Mr. Koebele has under my observation, or to my knowledge, under the observation of any of the other entomologists in Hawaii, been found to attack plants other than lantana. Even the Tingid, while it occurs quite freely on other plants, and in my belief will bear watching, has never been observed to injure other plants. At the same time there are many other causes that produce effects upon vegetation similar to those of the Tingid. I found in Kona, for example, a number of plants, particularly the leaves of the

Ti root and Peon d'Inde, used as supports to the Vanilla vines, badly infested with a species of red spider. Taro leaves were more or less infested with a species of aphid or plant lice. Citrus plants had the usual retinue of scale insects, with the purple scale at the head of the list. The coffee scale locally occurs also in considerable numbers, and finally the ubiquitous Siphanta or Torpedo bug. This last, while much less numerous than I saw it there in June, and certainly so than reported in August and September, was still present in excessive numbers upon every variety of plant. Aside from these insects there was ample evidence all around of injury by fungus diseases to a greater or lesser extent. Turning to Vanilla, all portions of the plant, including leaves, vines and pods, show quite a variety of mal-formation and discoloration. Particularly noticeable because of its abundance was a peculiar specking upon the leaves, even those that have apparently evolved but the previous day. At first glance these specks would lead one to suspect as being the result of an insect puncture, yet no insect was observed in the act of producing one, although vines were examined both during the day and by lamp light at night. The specks are brownish in color and surrounded by a translucent ring, being concave in some instances and convex in others. As many as thirty of them were counted upon a single Vanilla leaf. Hastily examined under the microscope, Dr. Cobb has found these specks usually located concentric with spiracles or breathing pores of leaves, which he suggested would indicate injury by microbes. He could, however, make no definite statement as to the nature of the parasite. In no instance was this speck observed to extend its area and its effect upon the vine is not apparent. All the other apparent defects in the Vanilla vines are evidently of a pathological or physiological nature, not attributable to insect work. Not being a specialist in fungus diseases my usefulness to Vanilla ceased at this point. As Massee states in his paper in the "Kew Bulletin," there are probably a number of diseases affecting Vanilla and nothing short of a study in the field by a plant pathologist will determine their nature and the effective remedies against them. On general principles I advised the Vanilla growers of Kona, and this

advice was sustained by Dr. Cobb and Mr. Lewton-Brain, to cut away and destroy all the affected portions of vines. To make cuttings by means of a tool, disinfected in a 10% solution of Formalin and to keep the vines covered with Bordeaux mixture, the standard universal remedy against all fungus diseases. At my suggestion Mr. Woods has sprayed his vines with this mixture some six weeks previous to my visit, and despite the daily rains the mixture was quite evident upon the vines, both upper and under surfaces when I saw them. If this application be made every two or three weeks the vines will remain completely covered by this coat of armor, proof against fungus onslaughts from without. After instructing the gentlemen in the principles involved in the preparation of this mixture, I left with them the chemicals (10 lbs. of blue stone and 10 lbs. of unslaked lime in a soldered tin) for the impending battle against the menacing fungi.

BROWN EYE SPOT (*Cercospora coffeicola*, B. & C.) AND OTHER COFFEE DISEASES IN KONA.

The brown-eye spot disease seems to extend its ravages farther and farther afield. The coffee growers estimate their loss at about 25% of their present crop owing to this pest. If this disease is altogether responsible for this terrible loss, terrible because of the present low prices on coffee, and if, as elsewhere suggested, the prevalence of this disease is due to the presence of *Siphanta*, also known as Torpedo-bug, we hope that by the aid of the *Siphanta* egg parasites, this evil will be eliminated. Among the first colonies of this parasite to be sent out went to Kona, and while it was too soon when I was there to determine whether the insect is established, we are confident that it is, and hope for good results from its work.

A number of coffee trees, often in clumps, were observed dead. Whether in consequence of this or some other disease it is hard for an entomologist to tell, as insects are not responsible for their death. The Territory is sorely in need of a plant pathologist and physiologist to clear up many of the mysterious tree-growing failures.

I may mention in this connection that the planters of Kona sought my advice with reference to the advisability of peti-

tioning the Secretary of Agriculture to detail a plant pathologist for temporary service in Hawaii until the diseases affecting principal crops here have been studied. It occurred to me as a very good idea, knowing that the U. S. Department of Agriculture occasionally does send out specialists to States and Territories in need of their advice and assistance. I merely suggested that such a petition be sent through and indorsed by the Board.

CITRUS TREES AND THEIR TROUBLES IN KONA.

Aside from the purple and other scales common on these plants in this Territory, many of the trees in Kona seem to suffer from the fungus disease known as "die back." In course of this investigation it became clear to me that the people of this Territory are sorely in need of a pamphlet on the scale insects of citrus plants and the effective remedies against them. Such a bulletin should be given immediate consideration. So long as we have no effective enemies of such pests as the purple scale (*Lepidosaphes beekii*, Newm.) and the avocado pear scale (*Pseudococcus nipae*, Mask.) we are compelled to urge artificial remedies to check them.

HORN FLY PUPAE.

(See page 130.)

LANTANA SCALE OR MAUI BLIGHT.

(*Orthezia insignis*, Dougl.)

On my way down to Kailua I observed this insect in several places upon lantana. This indicates that the ranchmen disregard entirely the warning of the entomologists of this office against the distribution of this insect. So far it practically confines its attention to lantana, although on Maui, as stated elsewhere, it has been observed in injurious numbers on several ornamental plants. How soon it will attack plants of economic value it is impossible to tell, but in view of the character of the insect the attack seems a certainty.

VI. PUBLICATIONS OF THE YEAR.

Two circulars (Circulars 1 and 2 of the Division of Entomology) were published since the last report, so was also a series of "Entomological Notes" in the "Forester," beginning with September. Some of the latter were reprinted in the body of this report. Since the "Forester" is not for gratuitous distribution, it seems advisable to reprint the remainder herewith. To give the circulars a wider distribution they are also reprinted herein.

ENTOMOLOGICAL NOTES FROM THE DIVISION OF ENTOMOLOGY OF THE BOARD OF AGRICULTURE AND FORESTRY.

BY JACOB KOTINSKY.

SIPHANTA OR TORPEDO BUG, (*Siphanta acuta*, Walker).*

Siphanta is the generic name of the insect generally known on these Islands as torpedo bug. Being shorter and more euphonious, it is preferable to adopt the uncouth name used hitherto.

The writer is unable to ascertain how long *Siphanta* has been upon these Islands. At present it is known to exist upon all the principle Islands of the group. It is much more numerous in some places than in others, and where it is numerous it occurs in prodigious numbers. It is still a mooted question among observers whether or not the insect is directly injurious. Some believe it to be harmless, while others, including the writer, are of the opinion that it scarcely can be other than a pest. The insect occurs in largest numbers during the seasons when plants grow most rapidly and congregate in immense numbers upon the tender shoots and leaves of the plants attacked. How can a plant endure having its life blood, the sap, pumped out of it through innumerable punctures in its tenderest parts without suffering materially? Moreover, the honey dew produced by the insect falling upon the foliage, induces the growth of that dirty black fungus characteristic of the presence of scale bugs and hoppers upon a plant; in fact

* Reprint from "Forester and Agriculturist," October, 1905, p. 295.

the Siphanta is a close relative to our notorious sugar cane leaf-hopper, is itself a leaf-hopper in structure and habits. But be this question of directness as it may, Mr. Koebele and others are of the opinion that it is responsible to a large extent for the distribution of the brown eye-spot of coffee (*Cercospora coffeicola*, B. & C.), so common and injurious upon these Islands. This distribution Siphanta probably accomplishes in the following manner: The mouth parts of the Siphanta like those of all true bugs, are fitted for taking up food in a liquid form only—by sucking. To accomplish this the insect inserts its proboscis or beak into the plant tissues until the sap-carrying cells are reached and then the pumping process begins. If this insertion was made at the point where spores or the fruiting stage of the disease were lying about, these may be carried down into the punctures where they germinate and grow, or they adhere to the proboscis when it is withdrawn and are carried to the next puncture. Moreover, when the proboscis is withdrawn the sap begins to ooze out of the wound and the liquid drops thus exposed make a favorable place for the adhesion of the fungus spores that may be blown about by the wind or carried by insects upon their feet. The prevalence of both the disease and Siphanta in coffee fields is strong evidence of the probable truth of Mr. Koebele's theory.

FLEAS AND DISEASE.*

That some insects are intimately connected with some of the most malignant diseases afflicting mankind is now an incontrovertible fact. Even the layman is at present aware that *Stegomyia fasciata* is the only vehicle by means of which yellow fever is transmitted, and that *Anopheles* is the intermediary and conveyer of malaria. In a recent investigation Dr. L. O. Howard, Chief U. S. Entomologist, has proven that flies which breed in excrement convey infection by typhoid fever. These facts have led scientists to a more thorough investigation of all human insect parasites and their relation to the diseases of man.

In an article published by C. F. Baker, of the Cuban Agri-

* Reprint from "Forester and Agriculturist, October 1905, p. 297.

cultural Experiment Station, in a recent number of "Science," he calls attention to the fact that fleas have been and still are suspected of transmitting plague and leprosy. In the case of malaria and yellow fever the medical authorities could make no satisfactory progress in their study of the relation between insect and disease before the insects were properly classified by an entomologist. This is also true of fleas; nothing short of a thorough and extensive collection and careful and systematic study of this group of insects will help to advance our knowledge of its relation to the diseases mentioned. Considering that fleas are blood sucking animals, and that they move about so dexterously and can cover a considerable distance at one leap, it will not be at all surprising if they are found to be the distributing agents of some of our most dreaded diseases. Mr. Baker has long been interested in a systematic study of this group of insects, and in the article referred to makes a call for an extensive collection of fleas. The writer will be glad to receive specimens of this insect from correspondents in the Territory and forward them to the proper authorities for study. Since leprosy is found upon these Islands, a collection of fleas from here would probably yield much valuable data on the subject. As it is not yet definitely known whether the fleas affecting man are the same species as those affecting the animals in his environment, it is well to keep separate those coming from different animals. It is advisable to secure as many specimens as possible, place them in about 50% alcohol, and label, giving host, locality, elevation, collector and date. To those who are interested in the subject it is advisable to be supplied with a pair of tweezers, some small homeopathic vials of alcohol and several rat traps, as it is especially desirable to determine the relation of the fleas affecting rats and man. As parasites usually desert their host immediately after the death of the latter, and as fleas particularly move rapidly, it is advisable to place a white cloth or sheet of paper beneath the animal and sprinkle freely with buhach. This will stupify the insects and as they drop off on the white background, they can easily be seen and picked up. The authorities promise to return reports of all specimens sent and to give credit to collectors.

A CIRCULAR OF INFORMATION.

BY JACOB KOTINSKY.

Assistant Entomologist.

INTRODUCTION.

One of the features of the Hawaiian Islands is that nearly every one, whether he lives in the city or country, is in one way or another interested in plant growth. Scarcely a door yard but has its ornamental plants, shrubs and trees. Very many of the inhabitants devote much time and attention to the cultivation of various fruit trees, some for private use only, others on a commercial scale. But the days when planting and irrigation was the only attention plants required, if they were ever here, are now past and gone. Vegetation upon these Islands is now beset with many ills, not the least among which is injury by insects. Numerous species of scale insects, cut worms, the Japanese beetle, the Olinda beetle, and many other insect pests, too numerous to mention in a circular, have come to stay with us. If there is consolation in numbers we may find it in the fact that our fate is not worse than that of the rest of the world engaged in the cultivation of plants. Man, however, acknowledges no insurmountable obstacles in his way of promoting desirable plant growth. With all means available to science he gives no quarter to his enemies. He fights until the battle is won.

WORK OF HAWAII AGAINST INJURIOUS INSECTS.

About twelve years ago the advance of the insect army upon our vegetation became so serious that the government was compelled to appeal to a scientist for assistance. The services of Prof. Albert Koebele were fortunately secured, and the war of insect extermination was earnestly begun. Relentlessly has the conflict been waged since that year, and the comparative scarcity of what were formerly pernicious pests is ample evidence of the success of the undertaking. More recently the Board of Commissioners of Agriculture and Forestry has organized a Division of Entomology to carry on the

work more effectively. With the object of drawing the attention of the people of this Territory to the work of this Division; in order to establish more intimate and frequent communication between the people suffering from insect injury and the workers in this Division from whom they may secure help, this circular has been written.

LOCATION AND OFFICERS.

The office and laboratories of the Division of Entomology are located in the building at the Government Nursery on King Street, Honolulu. The working staff consists of the following:

Alexander Craw, *Superintendent of Entomology and Inspector.*

Albert Koebele, *Consulting Entomologist and Entomological Explorer.*

Jacob Kotinsky, *Assistant Entomologist.*

C. J. Austin, *Inspector's Assistant.*

DUTIES OF THE STAFF.

The Entomological staff wrestles with all insect problems outside those affecting sugar cane. In general the work of the Division may be divided into four classes, as follows:

I. Inspection and Quarantine.

It has long been realized that practically *all* our insect pests are of foreign origin. At one time or another in the past they have been introduced into these Islands upon various plants and fruits brought from other countries. Those insects that have found the climate suitable and food in plenty have multiplied in proportion, and in time have become our pests. We have by no means exhausted the world's supply of insects that might become dreaded citizens of our fair isles. In order to keep those possible scourges from obtaining a foothold on our shores, a strict system of inspection and quarantine has been established by the Board. Mr. Craw, assisted by Mr. Austin, meets all incoming vessels and inspects all fruit, plants, tubers, etc., for insects or diseases that they may carry.

All such plants and fruits infested with insects or fungi not known to exist on these Islands are immediately destroyed. Plants that are infested with a species of insect already established here are fumigated with hydrocyanic acid gas. This gas is used at a strength that does not injure the plants, but kills all insect life upon them. The object of killing such insects is to prevent the infusion of new blood and vigor into those pests already here.

II. Search for and Distribution of Beneficial Insects.

Prof. Albert Koebele has virtually saved the vegetation of this Territory from disfigurement and utter destruction by means of the numerous lady birds and other beneficial insects which he has introduced from all parts of the world in the course of the past twelve years. This is a kind of entomological work of which only the State of California and the Territory of Hawaii have made a specialty. The almost clean and healthy condition of our trees and shrubs at present, in comparison with what it was before Mr. Koebele's coming, is sufficient testimony to the good work he has done. The services of Prof. Koebele are still at the disposal of the Territory. His mission is to travel in foreign lands, search for enemies of our injurious insects, and introduce them into the Territory. Moreover, he being the "Kamaaina" of the Division, his knowledge of the Hawaiian insects is of great value to the Division and the Territory.

III. Breeding and Distribution of Beneficial Insects.

A good deal of the work of this laboratory consists in the breeding and distribution of useful insects. Various lady-birds and minute four-winged flies are engaged in the good work of checking the rapid increase of scale insects, plant lice and other insect pests. As neither the "good" nor the "bad" insects are at all times equally distributed over the Islands, it is the business of the Division of Entomology to supply the "good" ones wherever they are needed. For this purpose a constant supply of some of this class of insects is kept in breeding jars and cages. Others again are collected outdoors and sent to correspondents.

IV. Study of Injurious Insects and Methods of Controlling Them.

Insect life, like all other forms of life, travels in a cycle. As in a cycle there is no definite beginning or end. On and on it rolls from father to son and from son to father. Full grown females produce eggs, from which hatch young, which after a certain period of growth, become mature and lay eggs in turn. The length of time consumed between any one stage in the life cycle and the same stage beginning the next cycle, as between egg and egg, varies with the species (kind) of insect, with the temperature and other climatic conditions. In the temperate zones, the active life of most living objects, plants and animals, is interrupted by the winter months. During cold weather most forms of life remain at a stand-still. The number of life cycles that any one species of insects would complete in a course of a year is thus reduced. Such is not the case in a salubrious, sub-tropical climate like ours. All forms of life continue in activity the year around. No stage of the cycle is omitted; neither is any stage of it extended because of cold, though normal variation due to fluctuation in temperature and moisture is bound to take place. Thus a species of insects that on the mainland produces from one to three *broods*, as cycles are sometimes called, if established here, breeds practically continuously and produces perhaps twice as many broods. The seeming calamity is atoned for by the equally rapid growth of vegetation. Where one crop a year is raised on the continent, two and three are grown here. Naturally, the more crops we raise upon a given area in course of the year the more attention we must devote to that area; in exact proportion to the number of crops and care given to a similar area in a colder climate on the mainland.

In a new environment the behavior of insects will change. The climate, amount of food, and number of natural enemies contribute toward this behavior. As said before, practically all of our injurious insects are of foreign origin, and, except those that are also injurious in the United States, little is known about their habits. We fight injurious insects with

their natural enemies whenever these are available. But in the case of injurious insects for which the natural check has not yet been secured, we cannot know too much about their habits and life history. A complete knowledge of these facts can alone reveal to us a loophole through which we can manage to bridle their ravages by cultural or artificial means. It is with the object of discovering these loopholes that we study the habits of injurious insects. There is still much to be done in this direction.

HOW WE HELP FARMERS AND PLANT GROWERS.

As already stated, when beneficial insects are available these are always supplied to applicants. When these are not to be had, however, we are able, in the majority of instances, to offer good advice, or prescribe efficient remedies. Thanks to the good work of Mr. Koebele we have on these Islands a good supply of most useful insects. At all time some of these are to be had in some place. Honolulu is excellent breeding ground for all of them, and we always have an eye on the places where certain species of these are to be procured, if we do not breed them in the laboratory. And thanks to the efforts of American entomologists we know of a number of standard remedies that are efficient against various insect pests. Either beneficial insects or prescriptions for remedies it is our duty to supply to our correspondents.

When our knowledge and farmers' needs warrant it we shall publish bulletins or circulars from time to time giving information on various insects or groups of insects. It is our belief that farmers ought to know enough about their insect enemies to be able to forestall serious damage by prompt and intelligent application of preventives. This kind of knowledge we hope to impart in our future publications. This, our first one, is of the nature of an introduction, and we hope will in a way prove useful to the farmer and home owner.

HOW TO SECURE INFORMATION ABOUT INSECTS.

It is both our pleasure and duty to study all phases of insect life. The farmer and grower of ornamental plants does it only when driven by necessity, and usually after the harm is done. Naturally, he cannot be expected to know at sight whether an insect is injurious or not. Very often he mistakes the "good" for the "bad." In Hawaii especially, all plant ailment is attributed to "blight." "Blight" is a very indefinite word. An insect may be biting or sucking its food; it may attack the blossom, leaves, branches, stem, or root of the plant. Sometimes, indeed very often on these Islands, the cause of the injury may be a fungus, a true blight. In each case perhaps a different remedy is required, and *unless we see the actual or supposed culprit we cannot suggest a remedy*. Therefore, when information about insects is desired, specimens should always be brought or sent with the inquiry.

WRITE.

We are always glad to see a farmer in our office making inquiries. But when he writes and sends us specimens, these and his letter, as well as a copy of our answer, are placed on file, and we are thus given an opportunity to keep record of his experience with the pest, and our work upon it. Moreover, the farmer can read our letter over and over again, and still keep it for future reference. Verbal advice given in the office he too frequently forgets before he reaches home. Our advice to him, therefore, is *write and send specimens*.

HOW TO COLLECT AND SEND SPECIMENS.

It is desirable to have specimens of the injury as well as the insect that inflicts it. We prefer *living specimens* when these are procurable. In the absence of these, dead ones will help us to identify the culprit. Collect during the day or at night, with lantern in hand, depending upon whether the damage is done during the day or night. We can identify adult (mature) insects more definitely, so collect these when

possible. But any stage will do when adults are not available, and all stages would be most satisfactory. Collect and send also specimens showing the nature of the injury. Place all the specimens in a small tin can or strong wooden box and mail them to us. No air holes are necessary. Biting insects, like caterpillars, require food, and some of their food should be placed with them. Scale insects may be sent upon a bit of their food plant inclosed in a tin or strong wooden box. A few specimens are sufficient. Wrap the box neatly in a paper, tie it, and write our address upon it. Address us: DIVISION OF ENTOMOLOGY, BOARD OF COMMISSIONERS OF AGRICULTURE AND FORESTRY, HONOLULU, T. H. In order that we may know whom the material is from, write your own name and address in the upper left hand corner. The stamps place in the upper right hand corner.

COOPERATION.

His time spent mostly in the field, the farmer has abundant opportunity for making observations, which may be brought to our attention only through him. These observations may sometimes be of the greatest importance, although they can be fully appreciated by an entomologist only. It is, therefore, highly desirable to both farmer and entomologist that the latter be informed of all important observations made by the former. In other words, it is to the farmer's benefit to keep in touch with the institutions directly concerned with his interests and which he helps to maintain. Farmers should make it a point to visit this office when possible, and write us when they need assistance. Send specimens, ask questions, try to learn from us all we know about insects, and tell us all you know about them.

Approved:

L. A. THURSTON, *President*.

Board of Commissioners of

Agriculture and Forestry.

Honolulu, Hawaii, April 25, 1905.

THE JAPANESE BEETLE FUNGUS.

BY JACOB KOTINSKY.

Assistant Entomologist.

INTRODUCTION.



FIG. 11.—Japanese beetle (*Adoretus umbrinus*, var. *tenuimaculatus* Waterh.): *a*, upper side of living beetle; *b*, upper side of beetle killed by fungus; *c*, under side of *a*; *d*, under side of *b*.

Perhaps no one upon these Islands has had more extensive experience with the propagation and distribution of this useful fungus than Bro. Matthias Newell of Hilo. With the assistance of the pupils attending his classes he has been able to inoculate and distribute tens of thousands of diseased beetles through Hilo and vicinity, besides a good many that went to other localities and other Islands. He asserts with authority that the fungus has been distributed to all portions of the group. His efforts in and about Hilo have been rewarded with success which to the writer's mind is due, first, to Bro. Newell's perseverance; and secondly, to the very favorable climatic conditions, namely, the abundance of rain in Hilo. Similar success under similar conditions has been attained in other districts of the Islands. In the arid districts, however, the fungus has not been as effective as would be desirable. This is readily accounted for by the want of ample moisture without which the disease, or more correctly, the fungous parasite cannot thrive.

STRUCTURE OF FUNGI.

As yet our knowledge of this fungus is limited. Like all fungi it is a plant of a very low order which grows in threads

(*Mycelia*) composed of elongate cells attached end to end, with occasional lateral mycelia of similar structure. After a certain period of growth some of the mycelia upon reaching favorable conditions, such as air in some, fructify. This fructification consists of the formation of a large number of minute sacks packed full of still smaller granules called spores. The spores in a way correspond to the seeds of higher plants. They are very light and extremely small, microscopical, so that when released from the enclosing sack they are blown about by the wind or transported from place to place by insects, birds and similar agencies. After lodging, favorable conditions, usually moisture and warmth, cause the spores to germinate and resume growth in form of mycelia. For nourishment fungi depend either upon living plants and animals or upon decaying vegetable and animal products. In the former instance they are classed as parasites and are regarded injurious or beneficial, depending upon whether they attack plants or animals useful to man or injurious to his interests. Thus the fungus diseases that attack our mangoes or coffee, for example, are injurious, while those destroying Syphanta or Japanese Beetles, are beneficial.

APPEARANCE OF FUNGUS.

Just where spores must lodge upon the Japanese Beetle in order to inoculate it is not yet definitely ascertained. We must assume that the germinating spores enter the body of the beetle either through the mouth or the spiracles, or pores, by means of which the insect breathes, one of which is generally located on each side of each ring of the insect body. In a message recently received from Dr. N. A. Cobb, Plant Pathologist of the Hawaiian Sugar Planters' Association Experiment Station, who generously devotes some of his leisure moments to examine fungus material for us, he states that while he found mycelia within the general body cavity of the insect, no traces of the fungus were observed, although looked for, in the alimentary canal. This would seem to indicate that the Japanese Beetle is not infected by means of its food. The fact is that, wherever the fungus enters the insect body, it propa-

gates and grows within the body cavity until it fills it completely. This mass within looks not unlike cheese with normal butter color. The insect at that stage looks unusually clean and polished brown. When the mycelia have filled the body cavity they force their way through the thinner portions of the body wall, usually the spaces (membranes) between the segments or rings or joints and appear as a very white cottony substance. The beetle itself is usually dead long before this appearance. In from twenty-four to seventy-two hours the sporangia, or fruiting sacks, are produced. The mass then looks greyish green and is of a somewhat powdery consistency.

In course of the past several years many people of these Islands have acquired the habit of reposing considerable confidence in the effectiveness of this fungus to check the ravages of the Japanese Beetle. In point of fact, if the necessary conditions for its propagation are supplied, either naturally or artificially, some degree of success is inevitable. Fortunately the beetle shows preference for plants about door yards, where favorable conditions for the propagation of the fungus can be created with comparatively little effort. I therefore take pleasure in inserting below the instructions from the most expert authority on the subject on

HOW TO INOCULATE JAPANESE BEETLES.

BY B. M. NEWELL.

Take a box about six inches deep, and fill about one half with damp soil. Keep this soil moist, not muddy, by occasionally sprinkling with water. Dry soil will not work. Collect a lot of beetles and place them in this box. Be sure to feed the beetles for they must not starve. The best time to place the food in the box is during the day, because then the beetles are mostly hidden in the ground. If the box be opened in the evening they will try to escape.

Valuable plants need not be taxed for their food, for any one may have noticed that even certain weeds are eaten by them. The so-called "honohono" grass is found in many places and beetles eat it readily.

Keep the lid of the box well down. No special precaution need be taken about air holes. Keep the box in a dry, shady place.

Beetles placed in such a box and properly cared for will die of the fungus, for the fungus which destroys them is now found in all localities.

A whitish substance grows out of the joints of the dead beetles, which after a few days turn green. The substance is the fungus. When a number of beetles have developed the green fungus, mix them well with some dry or nearly dry earth or fine sand, and scatter this mixture over and around the plants attacked.

Approved:

Board of Commissioners of
Agriculture and Forestry.

L. A. THURSTON, *President.*

Honolulu, Hawaii, December 1, 1905

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